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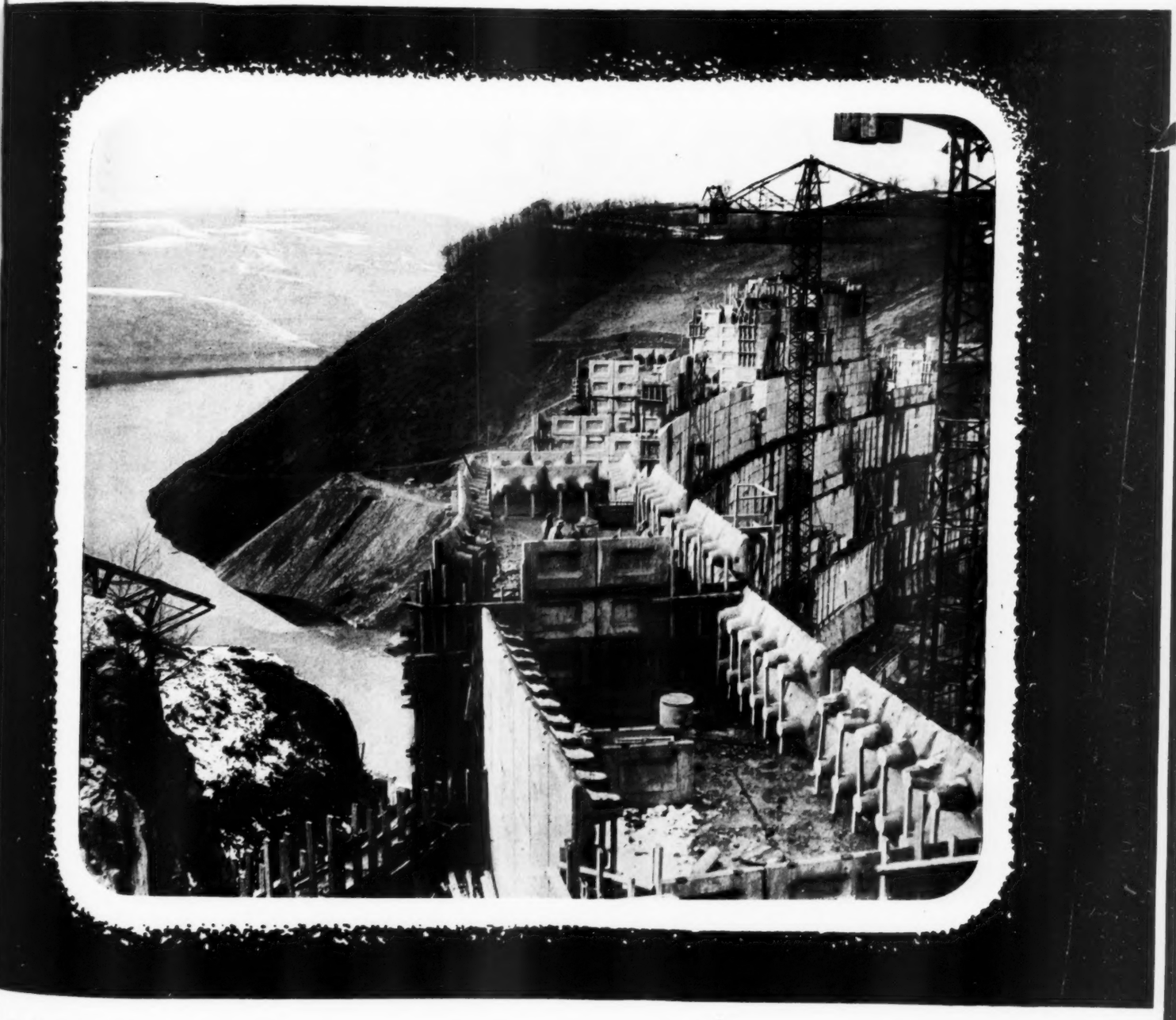

VOLUME 4, No. 6 JUNE 1952

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WORLD CROPS

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Vol. 4 No. 6 JUNE 1952

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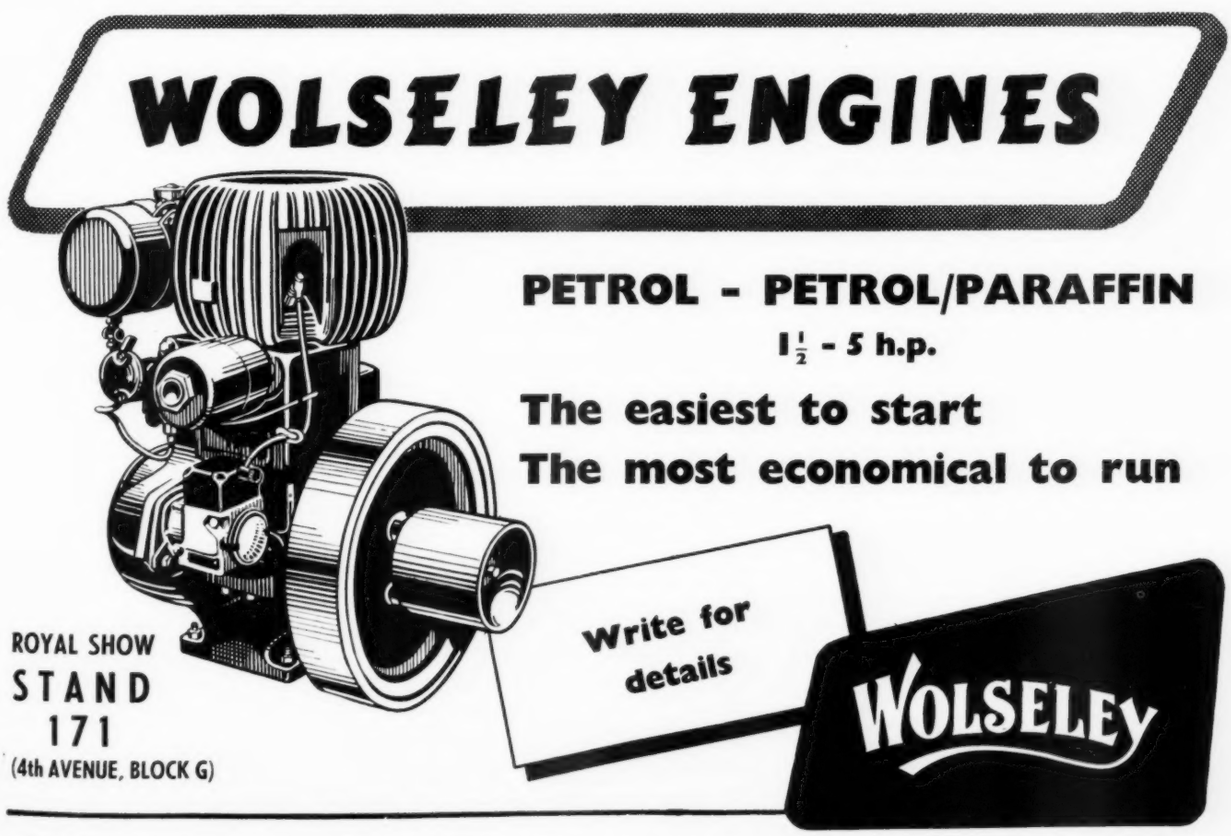
Published monthly by Leonard Hill Limited, 17 Stratford Place, London, W.1, England. (Tel. Mayfair 7383)

Subscription rates: *1 year 6 dollars, 3 years 12 dollars, paid in advance*



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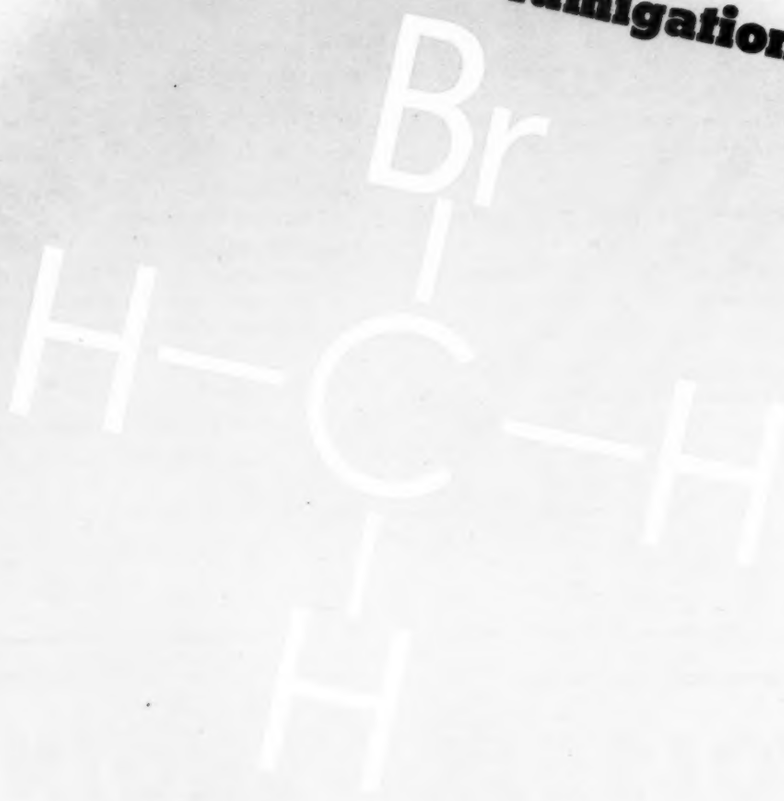

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Editorial Comment

British farm prices

AFTER unusually long talks with the farmers' representatives the British Minister of Agriculture, Sir Thomas Dugdale, Bt., has announced the new schedule of farm prices for crops (1953 harvest) and livestock (for the year ending March 31, 1953).

The accent this time is on more meat production. Substantial increases have been added to prices for beef, mutton and pigs. The price for milk has been increased by 1½d. a gallon which will help, but not altogether mitigate, the increased costs of production that producers have had to sustain during the last year. A welcome relief is the continuing basic price of feedingstuffs, the Government having decided not to raise their price to the farmer at least for another year. Schemes for continuing the ploughing-up grants, extending the fertiliser subsidies and renewing the calf subsidy are also being prepared.

The total amount the Government is awarding to the industry, including price increases and subsidies, is £39 million, which is £4¼ million less than last year. Details of the fixing of these prices will be released in the now customary White Paper which follows the annual price review.

In a statement given in the House of Commons the Minister described the award as 'just and constructive, providing a long-term policy which the Government is working out in conjunction with the leaders of the industry. . . .' He hoped that by 1956 the industry would have reversed the present downward trends in production and raised net output to at least 60% above pre-war.

Without details of the awards it is impossible to assess their significance fully, but it is plain that British farmers are being given the incentives to step up home meat production and restore the tillage acreage in particular. With the serious world shortage of food and little likelihood of cheap food imports the need for reliance on home farmers to increase production becomes increasingly apparent and it is evident that the Government regards the award as the foundation of a long-term policy of greater self-sufficiency for at least the next four years.

Toxic hazards

THE report of the Working Party appointed by the U.K. Minister of Agriculture in July 1950 to make recommendations for the promotion of safety of agricultural workers using toxic substances, which appeared early in 1951 and was commented upon in WORLD CROPS (Vol. III, p. 160), has now borne substantial legislative fruit by the introduction into the House of Lords on March 25 last of the Agriculture (Poisonous Substances) Bill, which provides for the protection of workers against the risks of poisoning by certain substances used in agriculture.

This is largely an enabling piece of legislation giving the Minister power to make regulations dealing with such matters as the provision of protective clothing and equipment, washing facilities for workers, supervision and training of operatives, periods of working and similar things.

The substances to which the Bill particularly relates are the dinitro compounds and the organophosphorus compounds, but its provisions could be extended to cover other substances used in agriculture should the need arise in the future.

The Working Party had, in fact, recommended that certain of the precautions should be given statutory effect and the passing of the Bill will enable this to be done. It is at least satisfactory to note that in the midst of acrimonious party political strife it is still possible for a non-contentious and highly desirable measure of this description to make the various steps in its progress to the statute book without undue and intolerable delay.

It is not regarded as possible for the legislation to be completed and the necessary regulations made in time to enable them to come into force for the earlier part of the 1952 spraying season, and in consequence a voluntary precautions scheme has been drawn up on lines similar to that accepted by the industry in 1951, with certain modifications, which have been shown to be desirable in the light of experience gained last season.

West Indian Sea Island cotton

SEA Island cotton, which is the finest and longest type of cotton produced in the world, is now exclusively produced in certain of the islands in the British West Indies. Formerly, it was extensively grown in the southern states of the U.S.A., but its cultivation was given up some 30 years ago, mainly on account of the depredations of the Mexican cotton boll weevil (*Anthonomus grandis*). This insect does not exist in the British West Indies, although it has already spread to the island of Haiti. If it should by evil chance penetrate to the British cotton growing islands it is more than probable that the extinction of the Sea Island industry would be only a matter of time.

Recently a difficulty arose in the West Indies owing to a project for the establishment of a cotton spinning and weaving industry in Trinidad, a British island in which no cotton is grown but which

is in close and frequent touch with the Sea Island cotton growing islands further north. The project was not designed to utilise locally-produced cotton but intended to rely on cotton imported from the southern United States and other foreign sources.

Actually, the machinery for the factory had been erected and the first consignment of cotton was expected, when it was discovered that under the local plant protection legislation the import of raw cotton from the U.S.A. was prohibited in the interests of the West Indian Sea Island cotton growing industry, to safeguard it against the introduction of the cotton boll weevil and other pests.

To meet the difficulty a conference was held between representatives of the local Government, scientists from West Indian agricultural organisations and authorities of the United States Department of Agriculture, at which it was arranged that any consignments of cotton shipped from the U.S.A. for manufacture in the Trinidad factory would be fumigated under the supervision of the U.S.A. authorities before they were shipped, thereby ensuring the destruction of any pests that might be harboured therein and affording the necessary protection to the West Indian industry.

That fumigation of cotton can afford protection against the introduction of pests, provided it is efficiently carried out, has long since been established by experiment, and indeed India has long been protected from invasion by this dreaded pest by means of fumigation with hydrocyanic acid.

It is to be hoped that the measures now contemplated will provide satisfactory protection for the West Indian Cotton Industry.

The Excess Profits Levy

LAST month we commented briefly on the recent British budget remarking that, unpleasant though its effects might be, on the whole, its provisions were sane and salutary. There is, however, one aspect in which it must, in the view of many industrial leaders and of ourselves, be regarded as severely discriminating against the best interests of the nation. We refer, of course, to the Excess Profits Levy.

During the past three years, which are the standard under the proposals, numerous firms have severely restricted their profits preferring to plough them back into their businesses in the interests of industrial development and future prosperity rather than realising them. The levy in its present form is therefore a serious disincentive and heavy penalty on firms which have adopted a policy likely to have a very favourable effect on the British economy in future years.

This has recently been pointed out forcibly by Sir George Nelson and by the Directors of the Decca Record Company. The Leonard Hill Technical Group which is the company responsible for the publication of WORLD CROPS and a number of other technical journals is also among those adversely affected, since these three years are precisely those in which the company has made its greatest efforts to extend the circulation of its publications, particularly overseas ; actually, the Leonard Hill publications can claim wider circulations outside their own country than the majority of their foreign contemporaries in the same fields.

During the past three years the attempt has been made to improve the position in this regard by a deliberate and complete curtailment of profits and by the ploughing back of all gains into the undertaking. Actually in one year there was a slight loss while during the remaining two years the profits did not amount to 1% of the turnover. In the year 1950, the not inconsiderable figure of over one million copies of the company's publications were dispatched, of which by far the greater proportion was sent overseas.

On the basis of both reason and logic there seem to be good grounds for a revision of this impost.

Improving the world's grassland

UNDER the above title we reviewed last month a FAO study prepared by Mr. A. T. Semple and recently published for FAO in the United Kingdom by Leonard Hill Ltd. The book surveys and focuses attention on the problems of range and pasture management throughout the world. Its publication synchronises with the attack which FAO is at present making on the whole question of pasture improvement at many different points and from a number of different angles. These have included the survey of pasture conditions in the Mediterranean region, an account of which appeared in WORLD CROPS, Vol. 3, pp. 425-429, the extensive exploratory work at present in progress in India and efforts in other directions.

In August of the current year there will be held the Sixth International Congress on Grassland Improvement at Pennsylvania State College in the U.S.A., a meeting which should be productive of important results.

Another interesting development is the announcement that a working party on Mediterranean pasture and fodder development has now been organised on a permanent footing and that its first meeting will be held in Rome during May. Delegations from 19 countries in the Mediterranean region are expected to attend the meeting, which is expected to devote attention *inter alia* to the general question of management and improvement of grasslands, the production, testing and distribution of seed of promising strains and varieties of herbage plants and the organisation of the exchange of information between authorities of different countries.

The meeting will have as the basis for its deliberations the report of the joint survey by FAO and

OEEC referred to above and the arrangements for holding it are the definite and logical follow-up of the preliminary steps of carrying out the survey.

As Dr. F. T. Wahlen, the Director of the Agriculture Division of FAO, remarks in the preface to Mr. Semple's book, '*hardly any world-wide project holds out more promises, simultaneously and in both directions, than a concerted campaign for the improvement of grasslands.*'

In launching this world-wide campaign FAO is rendering an inestimable service. Let us hope that these efforts will achieve a substantial measure of the success they undoubtedly deserve.

The Indian Plantation Act

REALISATION that conditions of work on plantations have special peculiarities and cannot be regulated satisfactorily through the provisions of existing factories acts has stimulated the Government of India to enact legislation for the control of labour conditions on plantations.

The matter has been under examination for some time past, the first proposal that a separate plantation code should be formulated having been made at the first meeting of the Industrial Committee on Plantations held in New Delhi in January 1947. Subsequently, the matter was discussed at considerable length with the interests involved and eventually the Plantation Act was passed through the Indian Parliament. It cannot, in these conditions, be claimed that the legislation has been sprung on the Indian plantation industry.

The provisions of the new act extend to the whole of India and apply to all plantations of over 25 acres employing more than 30 workers ; they do not, however, cover workers employed in factories on estates. It provides for a 54-hour working week, prohibits the employment of children below 12 years of age and of women and children between the hours of 7 p.m. and 6 a.m. It also provides for holidays with pay, the provision of canteens and crèches on plantations and for suitable housing standards for labour.

Commenting on the legislation insofar as it affects the tea industry in India the journal *Tea Trade and Industry* points out that while many of the provisions are unexceptionable others may give rise to difficulties. Thus the fact that labour in tea factories is controlled by legislation different from that which applies to labour in the field may quite easily occasion difficulties, while the position of casual labour which works seasonally on plantations to supplement its income from other sources may also prove a source of trouble. Moreover, while the Act itself applies to India as a whole, the State governments have each got separate rule-making powers under it and this may conceivably lead to confusion in operation.

The Act, must of course, be judged by results. If it disturbs employer and employee relationships on plantations which have hitherto been good, it would be unfortunate. On the other hand, new legislation of this description usually needs amendment, sometimes extensive amendment, before it becomes finally effective. If after necessary adjustments it settles down to smooth and steady operation it may well have repercussions in other lands where plantation enterprises exist.

Beyond antibiotics ?

A LITTLE more than twelve months ago (WORLD CROPS, April 1951, 124) we commented upon the remarkable development of antibiotics as growth-spurting additives for animal feedingstuffs. This development, already widely applied in the United States, is not yet officially authorised in Britain, a primary obstacle being our lack of production facilities for crude aureomycin; further tests are in progress to determine whether under British conditions the benefits obtainable are sufficient to justify the importation of substantial amounts of crude aureomycin. Already, however, a new development in the United States threatens to out-date this use of antibiotics. It has been found that similar growth-spurting effects can be produced by adding trace amounts of certain detergent chemicals to pig or chick diet. Tests at the Michigan State College have shown that hogs put on as much increased weight when one of these chemicals is fed as when aureomycin is fed. Other tests, involving more than 3,000 chicks, have also shown that a chemical with detergent or surface-active properties can increase rate of growth.

At first impact it might seem that American scientists have been trying chemicals at random as feeding supplements and that the detergent class has emerged as a pin-picked winner. This is far from the truth. The possibility that detergent properties might wield this influence in animal nutrition has followed directly from antibiotic feeding research. It was noticed that the most successful animal-feeding antibiotics were those whose molecules contained chemical groups which are generally associated with surface-activity. It was therefore speculated that this property might be an explanation of the growth-spurting effect and to test this theory, a detergent substance derived from a fatty acid was used as a feedingstuffs supplement.

And after

Considerably more research will be needed before the use of detergents in animal feeding can be generally recommended. Moreover, only certain chemicals of this type will be likely to be effective; most of them will inevitably possess other chemical properties that would actually retard growth or

cause ill-health. Nevertheless, the new turn in this still very infant subject has important implications. There seems little doubt that detergent chemicals could be produced on a large scale at a cheaper cost than crude antibiotics. For countries without adequate antibiotic production capacity, it should be much easier to set up facilities for producing these relatively simpler organic chemicals. Most important of all, perhaps, the argument so powerfully used against antibiotics—that their regular addition to animal diet may eventually encourage diseases through the development of resistant bacteria—seems quite inapplicable to the surface-active substances.

One deduction from all this has semi-cynical implications. If new developments in the same field of science are going to follow one another so swiftly, the most sensible course to adopt is that of the patient ' Wait-and-See-er '. For missing the bus is never a costly error when a better one may well be coming along behind! That is not to say that detergent additives *are* superior to antibiotic additives—there is not sufficient evidence available yet for any conclusion of this nature to be reached; but if they accelerate pig and poultry growth in the same way and possibly at lower cost, there will be fewer conjectural objections to their general use.

Down the river

THE Soil Conservation Society of America appears to be an extremely active body. Described as a professional organisation dedicated to the science and application of soil and water conservation, its aims may be said to be to further the efforts of the administration to secure proper and efficient land use throughout the territory of the U.S.A.

Recently the Society has produced an attractive and informative illustrated leaflet under the title which heads this paragraph, which in simple non-technical language sets out the importance of soil and water conservation and the dangers and disasters which can arise as the result of land misuse. Incidentally, it stresses the enormous losses of soil which take place whenever rivers come down in flood, a point which is underlined by the recent disastrous floodings in the Missouri valley.

The brochure in question is directed not so much to dwellers in the country-side as to the urban populations. It is, in fact, announced as the aim of the Society to place a copy of the brochure in every urban home throughout the American nation. This is a proposition of somewhat breath-taking proportions; nevertheless, none can gainsay the force of the argument that the bulk of the urban populations—the men who work in factories and their wives and children—have not been alerted to the fact that conservation of natural resources and efficient production on the farms is in the long run every bit as important to them as to the farmers themselves. One cannot but feel that this move towards awakening urban populations to the importance of rural production is one that might with advantage be copied in many other countries.

Urban populations and agriculture

HERE in Great Britain, for example, there is in the towns widespread and lamentable ignorance of, and apathy to the needs of agricultural industry. For generations urban workers have come, nay indeed, have been encouraged to regard things appertaining to the countryside as altogether outside their concern and as having no bearing whatever on their own welfare and prosperity. In extreme cases, politicians have even attempted to represent Government measures intended to improve the lot of agricultural workers or to enhance and increase agricultural production as attempts to bolster up and subsidise an effete and inefficient industry at the expense of the urban workers.

A community which depends for over 50% of its food on imports from overseas and relies on exporting manufactured goods—for the most part produced from imported materials—to pay for them, is in a highly dangerous position when as at present overseas countries are becoming increasingly reluctant to part with foodstuffs and are showing steadily growing sales resistance to imported manufactured goods.

It is manifest that with its present population, Britain can never hope to be completely self-sufficient in food supplies but it is equally manifest that food production could be raised to a point considerably above the present level, and that with present trends it is imperative that it should be. In the circumstances, obviously in a democratic state there should be widespread understanding of the agricultural problems among urban communities, since on their solution the survival of the whole population depends and to ignore them is to ignore the basic requirements for existence.

THIS MONTH'S COVER

A view of the dam at Bort-les-Orgues, Dordogne, France, under construction. This is part of the project for harnessing the waters of the Rhone, towards which more than 80 million francs in counterpart funds have been contributed. Besides supplying much-needed hydro-electric power, the water will also help irrigate the fertile valleys further down.

(F.C.A. Photo)

The Egyptian Cotton Industry

PART I

C. H. BROWN, B.Sc.

Late of the Egyptian Ministry of Agriculture

The development of the Egyptian cotton industry is one of the major events in tropical and subtropical agriculture; today, Egyptian cotton plays a unique part among world textiles. Below we reproduce the first of a series of three articles which describe and discuss the Egyptian cotton industry. The writer was for many years plant breeder in the Egyptian Ministry of Agriculture and took part in the origination of many of the varieties of Egyptian cotton that are well known today.

IT is interesting to recall how recent cotton is as one of the world's major crops. The historic fabrics of antiquity were linen, wool and silk when cotton was a novelty from India. Yet in the last few centuries it has spread as a cultivated crop practically all over the world, until now the quantity of cotton grown and used is greater than that of all other textile fibres put together. Perhaps no other plant except the potato has conquered the world as quickly.

It is clearly the variability and adaptability of *Gossypium* as a genus which have been the key to this success, for the same cottons have not succeeded everywhere. Starting from what were presumably a large number of wild species in both the Old World and the New, there are now roughly four main cultivated groups: the Sea Island, the Egyptian, the American Upland and the Asiatic cottons. Each has naturally its special points of interest, but the main economic importance of the Egyptian type is that it provides the bulk of the world's high quality cotton. Although now successfully grown in other areas, to be referred to later, much the most important quantity of Egyptian cotton is grown in Egypt itself, where it is now the dominating crop.

Labour is cheap and plentiful for picking Egyptian cotton

The genesis of the industry

The story of the discovery by Jumel—a French textile engineer invited to visit Egypt by Mahomed Ali—of a garden tree cotton is too well known to need repetition. Following the success of the first trials with the new seed, Mahomed Ali apparently used strong influence to push its growth on a wide scale. Jumel cotton, as it came to be called, was a tree cotton, but its success encouraged the importation of seed of all types from all over the world. It would be fascinating if more were known of the origin and quality of the introduced types, but, unfortunately, that is impossible. With no scientific advice available, and little or no general understanding even of the importance of keeping different seeds separate, it is quite certain that there was an enormous amount of mixing and crossing. These are, of course, the ideal conditions for the natural selection of a type suitable to the local environment, and over the first half of the 19th century such a type was evolved. This was an annual and that it showed plenty of variability is clear from what I believe is the oldest surviving record, *viz.* a diary in the possession of the Cotton Research Board Library at Giza, dating back to 1858 and 1859, and written by one James Byrne, apparently employed as an adviser on a large estate. Byrne records the selection of cotton seed for sowing, and especially the separation of white from yellow cotton.

In this melting-pot were certainly included strains of Sea Island cotton from the United States or the West Indies, and it may be taken for granted that it was this particular genetic component which gave the high quality element in the Egyptian crop. Egyptian cotton as it exists today is, however, a type distinct from Sea Island; in particular it is appreciably earlier maturing, so much so that at the present time imported Sea Island cotton cannot be successfully grown in Egypt to give an economic crop. There existed, however, in the Sahellarides strain of the early years of this century at least one point other than its staple, which indicated a Sea Island ancestry; this was the common susceptibility of the two types to *Fusarium* wilt disease. This susceptibility was carried on into the succeeding top-quality variety Malaki, and caused serious loss of crop; it has, however, now been successfully bred out of the whole genetic composition and all present strains are resistant to it.

Development

As the success of the semi-purified varieties of the middle of the 19th century became apparent, spinners, and more par-

ticularly those of Lancashire, grew to depend more and more on Egyptian cotton. Its final jump to full importance as a major world crop was, however, undoubtedly a result of the American Civil War. In their search for substitutes for American cotton, which they were unable to obtain, spinners bid up the prices of Egyptian and stimulated a sharp increase in the acreage cultivated. From this point the history of the Egyptian agriculture has become the history of the cotton crop. It has never looked back; there have been slumps in prices, but these were generally part and parcel of a general economic slump which carried down the prices of competing crops as much as it did those of cotton. Even then, at the lowest prices cotton has touched there has been no tendency to forsake cotton growing for other crops.

New factors

In the early years of this century three new factors appeared; one of these was the introduction into Egypt of the pink bollworm, which dealt cotton production a major blow. On the other hand, this was more than counterbalanced by two new favourable factors. The first was the discovery by a Greek, Sakellarides, of the famous cotton which came to bear his name. This marked a new high point in Egyptian cotton quality. As suggested above, the presumption is that it represented an approximate purification of a line of Sea Island or partly Sea Island ancestors which had existed continuously as one component of a mixed crop. Even Sakel itself, as I knew it in the twenties, was by no means a pure strain. But it became the parent of a long line of high quality cottons, all of which carry its blood. These higher quality varieties have proved to be particularly suited to the more humid climate of the Nile Delta; the lower qualities typified by the Ashmuni strain have been driven into Upper Egypt. It should be noted, however, that the town of Ashmun, from which this variety derived its name, is actually in the southern part of the Delta.

In the early years of this century cotton growing in Egypt was mainly confined to the Nile Delta; it was not until the completion of the Assuan Dam in 1902 that the serious conversion of the basin irrigated lands of Upper Egypt to perennial irrigation could begin. Slowly the spread of summer watering, on which cotton growing depends, has continued further and further south. Today it is only the extreme southern provinces which remain under unconverted basin irrigation, where there are considerable areas of excellent black soil waiting the development of perennial irrigation to bear their first cotton crop. The importance of these new areas is that yields per acre on these deep alluvial soils are higher than in the Delta, while the relatively short staple cotton grown there has acquired a safe niche in the world's cotton markets.

Area cultivated, production and consumption

The area cultivated under cotton in Egypt has expanded considerably since the commencement of the present century. Thus in 1900 the area planted in cotton was 1,230,000 feddans,* but by 1930 it amounted to 2,082,439 feddans. The actual area planted fluctuates considerably from year to year. During the war years 1942 to 1945 it diminished considerably, but since peace was restored the cultivated area has resumed its former figures.

During the same period the total production has ranged between 3,500,000 cantars† and close on 11,000,000 cantars, while the mean yields per unit area have fluctuated between 3.06 and 6.06 cantars per feddan.

The figures for acreage cultivated, total production and mean production in cantars per feddan for the past 10 years are given in Table 1.

TABLE 1

	Acreage in Feddans	*Production in Cantars*	*Yield per Feddan Cantars*
1942/43 ..	705,000	4,154,000	5.90
1943/44 ..	712,812	3,494,000	4.91
1944/45	852,919	4,514,000	5.34
1945/46 ..	982,430	5,113,000	5.21
1946/47 ..	1,211,731	5,920,000	4.91
1947/48 ..	1,254,154	6,250,000	4.98
1948/49 ..	1,441,455	8,735,000	6.06
1949/50 ..	1,692,004	8,517,000	5.03
1950/51	1,974,559	8,303,000	4.20
1951/52 ..	1,979,453	7,454,000	3.77

The production is mainly exported, but of late years an increasingly large share has been consumed locally in the Egyptian spinning and weaving industry. The figures for exports and local consumption in cantars for the past nine years are shown in Table 2.

TABLE 2

	Exports in Cantars	*Consumption Cantars*
1942/43 ..	2,070,000	891,000
1943/44	3,611,000	875,000
1944/45	4,227,000	967,000
1945/46	4,413,000	1,047,000
1946/47 ..	6,955,000	1,186,000
1947/48	7,968,000	1,163,000
1948/49	7,936,000	1,288,000
1949/50	8,838,000	1,249,000
1950/51	6,426,000	(*b*) 1,374,000

(*b*) Revised.

Egyptian cotton in world markets

The fine spinning trade of Lancashire has come to depend primarily on Egyptian cotton, the better quality varieties of which largely replaced Sea Island. The Sea Island cotton crop in the United States was severely attacked by insect pests and its cultivation has now been practically abandoned there. It is only the few spinners who require a cotton finer and longer than the best Egyptian who now use West Indian Sea Island cotton. The latter is important as an example of what fine cotton can be, but the production is not large enough seriously to affect the dominating position of Egyptian cotton in the quality market.

In the United States the better types of Upland cotton compete with the lower end of the Egyptian range and practically only the best Egyptians are bought, but these

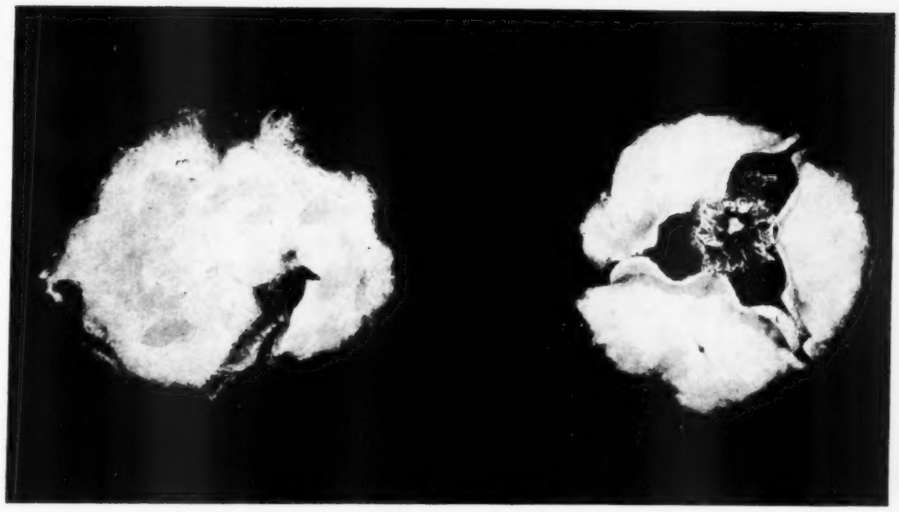
* 1 feddan = 1.038 acres.

† 1 cantar = 99.05 lb.

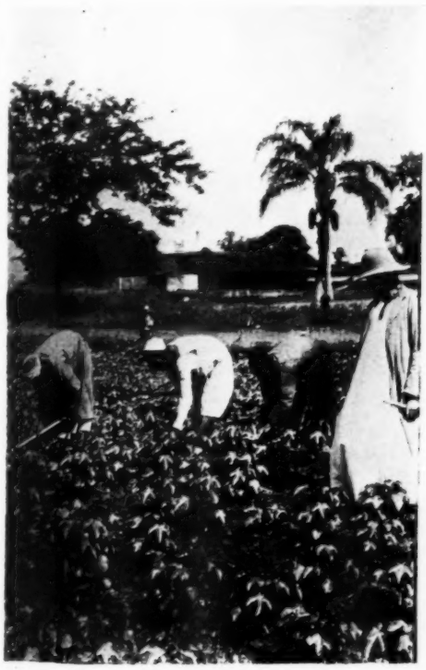
Irrigating a cotton field after sowing

are indispensable for certain uses, *e.g.* sewing thread.

India has since the war sharply increased its takings of Egyptian cotton until now it is the second largest export outlet. The tendency here is to use the lower grades of the longer-stapled varieties. All the main European countries now take their quota of Egyptian cotton, France and Italy being the two most important. But Lancashire, just as she was the first customer, has remained the most faithful standby. The whole range of Egyptian qualities are used and, although for some of the very finest yarns the top qualities are required, the English market is perhaps more notable for the large proportion it uses of Ashmuni cotton. With the Ashmuni of Upper Egypt is now grouped under the name of Zagora the same type of cotton grown in the Delta, where it produces a rather coarser fibre. The Upper Egypt type is widely used in Lancashire in carded yarns, where its easy working and relative freedom from nep commend it to spinners.



Sakellaridis cotton boll, side view and from beneath



Workers in the field hoeing young cotton plants

For many uses Egyptian cotton is now standard. For the better descriptions of sheetings, handkerchiefs and drill Upper Egyptian cottons are mostly used. They are still used as tyre yarns wherever cotton has not been replaced with high-tenacity rayon. The medium Egyptian types now mainly represented by Giza 30 and Menufi are used for poplins and shirtings, as well as for medium quality sewing thread yarns. The top quality Egyptian cottons now go mainly into the finer sewing threads, embroidery cottons, lace yarns, yarns for electrical uses and for typewriter ribbons.

The price factor

In considering the problem of cotton uses and markets, and especially those of the better quality cottons, the predominating importance of price must always be borne in mind. High quality cottons consistently sell for a premium over the basic American Upland type, and this limits their potential uses, since naturally spinners will not pay the higher prices except for uses in which better quality cotton is essential.

Egyptian cotton in other countries

The premium for Egyptian types of cotton has naturally induced cotton growers the world over to try to improve the quality of their crops to the Egyptian level so as to enable them to take advantage of the premium. It has, however, proved difficult to find comparable areas and conditions in other parts of the world. The most successful area has undoubtedly been the Gezira in the Sudan, where the cotton grown is partly of Sakel types, from seed originally imported from Egypt, and partly new selections and crosses produced by the Gezira research workers. The Sudan industry is described in recent articles in WORLD CROPS by Mr. H. Ferguson (Vol. IV, 1, 2 and 3, Jan., Feb. and March 1952).

There have also been some interesting developments in the irrigated valleys of Arizona and California, where seed of the Mit-Afifi cotton, then the predominating type grown in the Nile Delta, was imported in the early years of this century. After reselection on the spot there was evolved a type known as Pima, which proved suitable to the local conditions. More recently the intrinsic fibre weakness of this variety has been improved by crossing with newer Egyptian introductions. These cottons have supplied in moments of crisis the whole American demand for Egyptian type cotton, but costs of production are so high as to make their cultivation uneconomic in free competition with cotton grown in Egypt. The future of this type in the United States therefore seems to depend on the extent to which the U.S.A. Government decides to give it artificial support in the form either of guaranteed prices to producers or quota and tariff restrictions on the competing Egyptian product.

Egyptian cotton has also been grown with some success in the Transcaucasian province of Azerbaijan, in Soviet Russia, where, with irrigation from the River Kura, comparable conditions have been reproduced. In the outside world little has been heard of this crop recently, but there seems reason to believe that it is an established technical success and largely supplies Soviet requirements for high quality cotton.

In the Sind province of Pakistan there have been prolonged trials with Egyptian cotton, but with no satisfactory results, the climate being apparently too hot and dry. Peru also grows a little Pima cotton, and the same type has been introduced into French North Africa. Here, with new irrigation schemes, there are appreciable areas where production could be expanded, although the quantities grown so far have not been important.

The upshot of all this is that the world remains dependent on Egypt for more than three-quarters of the supplies of superior type cotton. In Egypt immense success has followed developments of the irrigation system and improved techniques of cultivation, spacing, manuring, etc., have given

excellent results. In addition, new varieties have been bred which are more and more closely adapted to spinners' needs.

The outlook

All this has given the Egyptian cotton industry many advantages; in addition, the low standard of living of the Egyptian peasant cultivator makes available a supply of cheap labour, which, however much it may be condemned from a human and sociological point of view, nevertheless must be regarded as a major asset when viewed from the standpoint of competitive marketing.

We have already seen that even in areas in other parts of the world which are able to duplicate Egyptian climatic and soil conditions, and which are equally well provided with technical services, it has been found impossible to compete with Egyptian cotton, mainly owing to higher labour costs. Moreover, in determining costs of production a high yield of lint per acre is, of course, a very important factor, and here Egypt's average yield of lint, which stands at 500 lb. per acre, far exceeds averages in the United States or India and is only approached by those obtained in the Sudan and Peru.

Indeed, there does not appear to be any very obvious reason why yields exceeding the present very high average should not be obtained in the future, and actually varieties which appear capable of giving higher returns than those at present cultivated are under test.

The main difficulty at present in the way of the attainment of still higher yields is the prevalence of numerous insect pests and if better control of them could be secured it would bring the ideal of higher yields materially nearer achievement.

Effect of insect pests

Insect pests are such an important factor in Egyptian cotton production at present that they require special mention.

Bollworms. The spring bollworm (*Earias*) has long existed in Egypt. The pink bollworm (*Gelechia*) was introduced about 1915 and seems to have submerged *Earias*—at any rate in the Delta and in the northern part of Upper Egypt, where *Gelechia* takes a steady and consistent annual toll.

As one proceeds further south, however, the damage done by *Earias* increases, this insect apparently being able better to withstand the extreme heat of the sun. The principal factor in the control of these pests is the restricted length of the ginning season, which is imposed by law, and the heat treatment of seeds given in the ginnery, which kills insects wintering in the seeds. *Cotton leaf worm* (*Prodenia*) must also be considered a major pest, although the damage it does varies from season to season and from district to district. A really bad attack could, however, practically destroy the whole crop. To control it children collect egg masses in early stages, while when attacks become serious insecticides are used. Mixtures of DDT and BHC with a filler have also been found very effective in controlling cotton leaf worm, but it is suspected that they may also kill predators which help to keep in check aphids and bollworms. Indeed, increases in the attacks of *Earias* have been observed to follow the use of these dusts. On the other hand, there is also evidence to show that if mid-season dusting to control *Prodenia* is followed up with subsequent dustings or sprayings later in the season it may help to reduce bollworm incidence.

One consequence of the ravages of insect pests is the extravagant importance which has become attached to early maturing varieties of cotton. There is, in fact, a race in the development of the cotton crop and the insect pests which attack it, and the aim has always been to produce varieties which mature their crop sufficiently early to prevent the pests doing too much damage. No one, in fact, has the slightest idea what potentialities might be found to exist among later maturing types if they could be isolated and adequately protected from insect attack.

To the writer it seems that other lines of approach could be usefully essayed. It seems clear that the prevalence of pests under Egyptian conditions must depend on their carry-over from one season to another and that the possibility of cutting down these over-wintering numbers is worthy of most serious study.

Thus the carry-over of *Prodenia* depends on the existence of winter berseem crops on which the insect thrives. The last date on which winter berseem can be watered is fixed by law to check the pest, but the law is widely evaded and more stringent enforcement might bring good results.

Again, the last date for ginning is fixed by law in order to control bollworms, but the term is often extended at the request of ginners. It seems not improbable that if, instead of acceding to these requests, a systematic attempt was made to compress the ginning of the crop into an even shorter season a spectacular reduction in bollworm incidence might result.

One cannot, of course, be certain of this, but at least it seems worth trying. If such measures resulted in a marginal gain of only 5%, the total effect on the cotton crop of Egypt would be very considerable; it would give an extra fillip to the whole cotton trade, while it would also improve the grade of the crop.

Photos: Egyptian Education Bureau, London

Sierra Leone Using Tractors to Boost Land Reclamation

The immediate undertaking of large-scale mechanised rice production in the South-Western Province of Sierra Leone, following tests made during the past two years which resulted in 600 acres being brought under rice, is now claimed to be justified, according to a report by the Colonial Office Information Department.

The Sierra Leone Legislative Council has voted £72,000 for the main scheme which is being undertaken in the Sewa-Wanje River area, near the port of Bonthe. British-made tractors have been satisfactorily tested; more have been ordered and are now arriving, and it is hoped to clear about 1,800 acres before the end of the current year.

Surveys have already shown that there are approximately 60,000 acres of virgin riverain grasslands in the Southern Littoral and some 40,000 acres of swamp grasslands in the Scarcies areas, all of which should be suitable for tractor cultivation and capable of producing good rice crops year after year.

In addition, there are some 100,000 acres of undeveloped mangrove swamps. In the past 12 years, some 8,000 acres have been cleared by hand methods and 6,000 acres are producing good crops of rice. Readers may remember the article by Mr. Hector MacLuskie in the April issue of WORLD CROPS, in which he described the reclamation work that has been carried out in the Scarcies Delta.

Mechanical means of clearing forest swamps have been tried, but so far this has proved intractable, and hand-clearing may be the only suitable method. Hand methods have been responsible for the clearing of nearly 50,000 acres of mangrove in the Scarcies and other areas over the last 70 years. If a mechanical solution to mangrove clearing can be found, progress will be greatly accelerated.

Continuous research into the suitability of various types of rice has been conducted for some years at the Rice Research Station at Rokupr, where 198 strains and varieties are under trial. This station is being considerably enlarged from funds provided under the Colonial Development and Welfare Act—£73,000 is being spent to establish it as a major Rice Research Station for the whole of West Africa.

The Soilless Cultivation of Plants

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The soilless cultivation of vegetables is a subject which has attracted much attention of recent years, and the following paper, which was read at the 70th Annual General Meeting of the Society of Chemical Industry discusses a number of aspects of the matter.

As long ago as 1699 Woodward published an account of his observations on growing cuttings of plants in water instead of in soil. He used rain and river water and his account may perhaps be the earliest record of a simple, crude, water culture experiment.

Ninety years ago the classical experiments of Sachs (1860) and Knop (1860) showed not only the possibility of growing plants to full maturity in water to which salts were added, but also led to the recognition of the essential elements required. From their results arose the belief that 10 or 11 elements were all that were essential for plant nutrition. Investigations based on Sachs' and Knop's methods have continued ever since. A modification was the use of pure sand, or similar material, to support the plants. These two methods of water culture and sand culture have revealed the effects of the various nutrient elements on the plants. By their use knowledge of mineral deficiencies accumulated and much was learnt of the plants' responses to the uptake of different elements. The methods later revealed the essential nature of the trace elements so that to the lists of Sachs and Knop were added boron, zinc, copper, manganese and molybdenum.

Before soilless cultivation was tried on a commercial scale knowledge and experience had been gained by small scale tests.

Tests on a semi-commercial scale

Fifteen years ago Gericke (1937) tested water cultures as a method of crop production in California. The plants were grown with their root systems in solutions, in tanks or troughs, and their stems mechanically supported. Much attention was attracted by the reports of the large yields obtained.

In this country various methods have been tested, the majority of these tests having been carried out under greenhouse conditions with horticultural crops. Templeman and Watson (1938) proved solution culture to be unsatisfactory, partly owing to the lack of aeration of the roots and also because the method had serious practical disadvantages both of manipulation and technique. Arnon and Hoagland (1939) by the use of forced aeration of the solutions increased the yield of tomatoes to a level above that obtained from soil, but there are easier and less expensive methods of providing root aeration. Stoughton (1941) also pointed out the wide difference in the light conditions and other factors of the environment between California and this country that might go far to explain the difference in the results observed with water cultures.

Soilless beds with lettuce; note absence of weeds and shade

Using sand and/or gravel, Templeman (1941) also tested the surface watering method which demands very little if any special equipment as the solutions can be applied by hand. He later utilised a system of dilution of the concentrated nutrient solution whereby tap water passing to the surface of the sand received the necessary charge of nutrients; this method economised storage space and avoided the necessity of making repeated dilutions.

In another method diluted nutrient from higher level reservoirs dripped on to the sand in which the plants were grown. The solution, after percolation through the sand, was collected and pumped back to the reservoir. Aeration was provided by the small drops passing into and out of the sand. Watertight containers are here a necessity; some difficulty arose from the growth of green algae blocking the delivery jets in the earlier tests.

A more manageable and successful technique proved to be the sub-irrigation system of Withrow and Biebel (1936) for which Mullard designed a layout with automatic controls (1940). The beds, constructed of pre-cast, were rendered watertight by high quality asphalt; they were filled with gravel and from the storage tanks the nutrient solution encouraged aeration.

A simple method of gravel culture is the dry application method used by Hicks and Tincker (1944). The nutrient mixture of salts is applied in dry sand between the plants and then watered into the sand or gravel. Free drainage is a necessity and skill in watering is required; this method has given satisfactory results with carnations.

Sand has been replaced recently by vermiculite in some methods.

Some of the results

1. *Surface watering.* Good yields of tomatoes were obtained at Jealott's Hill commercial nurseries by the surface watering system, surpassing the soil average yield in certain years by 25% or so. Carnations also gave satisfactory results, and lettuces yielded well in both heated and unheated houses.

2. *Automatic dilution.* With several tomato varieties, satisfactory average yields were obtained and in a larger-scale commercial trial of five varieties, tomatoes yielded 49 tons per acre compared with 45 tons from soil. Good crops of carnations have been produced on a commercial scale, approximately equal to those from plants in soil.

3. *The drip culture system* has given high yields of good quality tomatoes from plants grown in late summer and autumn.

4. *With the sub-irrigation method* a

number of varieties of tomatoes have given satisfactory results over a reasonably long period at Reading, Egham and elsewhere. It has also given satisfactory crops of carnations and lettuce, and gerbera and arum lilies have produced high quality flowers. Many other plants have given good results in small-scale tests.

Larger-scale installations

(a) Ascension Island

During the war large numbers of service men were sometimes stationed in areas where there was little available soil for the production of vegetables. The U.S. Army Air Force (1946) built and operated its Hydroponic Station No. 1 on Ascension Island, and further stations were set up in British Guiana, on Wake Island and in Japan.

The beds used at Ascension Island were arranged in four sections each of 25; they were terraced and some 115 ft. to 85 ft. long, 3 ft. wide and 8 in. deep, spaced 4 ft. apart and built of concrete asphalted over, filled with the local black volcanic cinders. Each section was filled by drainage from a higher level.

The water used was distilled from sea water; some water economy was practised by shading the whole installation, the surface of the cinders was also covered and the lettuce and other plants grew through cut slits. Irrigation took place every second day. The equable climate permitted cropping all the year round and crops of lettuce, radish, cucumbers and tomatoes were grown successfully. In such circumstances, with materials and abundant labour available, economic considerations did not receive primary attention.

(b) The Bahamas

On New Providence, Bahamas, there are only a few small areas that can be cultivated by the usual means; the 'soil' largely consists of pockets of humus in the calcareous rock of coral origin. To break up such a surface to a fine tilth is expensive and not always entirely satisfactory.

As an integral part of a development scheme a unit of soilless cultivation has been established by private enterprise with the approval of the Government of the Bahamas.

Preliminary small-scale trials were conducted using copper lined beds 22 in. by 12 in. by 6 in. The main installation comprises 42 beds each 175 ft. long by 32 in. wide. As the difference between day and night temperatures is fairly wide, expansion and contraction of the concrete presented some difficulty in regard to watertight joints. Each bed has a central tile channel 6 in. wide which can be closed by a small sluice gate; this is used for the irrigation of the aggregate in which the plants grow and permits complete drainage later. These 42 beds provide a total length of approximately 1½ miles. The solution drains into 40,000 gal. tanks; it is pumped from them by an electrically driven pump, delivering 50,000 gal. per hour, capable of flooding a panel of 11 beds in 20 minutes.

Crops grown

The seasonal production of lettuces approaches 50,000; tomatoes have been successful and celery of the finest quality has been grown. The details of irrigation and concentrations require slight seasonal modification for different crops. For example, lettuce grows well in the winter months with two pumpings daily until within two weeks of cutting, when once daily is sufficient; celery responds to longer periods of flooding and slower drainage when young. Tomato varieties vary, but small plants only need one flooding daily, fruiting plants may need two or three floodings daily according to their size.

Certain European tomato varieties showed a tendency for their fruits to split in the summer months. Solutions about twice as dilute as are used for lettuce have proved more satisfactory for tomatoes. Further tests are in progress with newly-raised varieties obtained from lower latitudes, and trials of other plants suitable for the hotter seasons are being undertaken.

Culture solutions

For the critical water cultures the very purest salts are required, but for large-scale sub-irrigation work fertiliser-grade salts have been successfully used. Their very impurities may be of value, and no doubt small quantities of trace elements have been supplied in this way. There are many possible combinations of salts and it was quickly realised that there is no such thing as a best possible mixture. There are, however, certain guiding principles. Templeman (1947) based the ratio of nutrients on the observed ratios of uptake from fertile soil which yielded good crops. In the case of tomatoes this proved to be N; P_2O; K_2O: as 2:1:4.

Reasoning from experience with plants growing in soil, where applications of potash proved beneficial, successful attempts have been made to modify the concentrations of the nutrients both as the season dictates and as the phase of growth of the plants demand.

Under the conditions of the Bahamas, certain varieties of tomatoes have shown a tendency to grow vigorously and to set fruit too sparsely; modification of the nutrient solution to decrease the nitrogen has resulted in a more satisfactory balance between vegetative vigour and fruit production.

Similarly, Templeman reports that carnations gave indications that frequent modifications of the nutrient solutions proved helpful in obtaining the kind of growth desired for commercial purposes. There is evidence that different crops tolerate and prefer different concentrations of nutrients. Lettuce can be grown at a higher concentration than tomatoes.

A few examples of nutrient mixtures used must suffice.

Templeman's (1947) mixtures of fertiliser grade chemicals was:

	oz.
Nitrate of soda	10.5 (15½% N)
Superphosphate	5.6 (14% P_2O_5)
Sulphate of potash	4.9 (48% K_2O)
Magnesium sulphate	3.8
Minor elements (concentrate)	1 gal. approx. all dissolved in 100 gal.

Stoughton and Mullard (1941) have suggested the following mixture for carnations in summer; the concentrate of potash is increased and nitrogen decreased in the shorter winter days:

	Per 100 gal.
Nitrate of soda	28.2 oz.
Superphosphate	14.6 ,,
Sulphate of potash	2.6 ,,
Magnesium sulphate	8.8 ,,
Sulphate of ammonia	2.0 ,,

Individual mature lettuce of 'Great Lakes' variety

Tomato plant showing too vigorous vegetative growth with too low a carbon nitrogen ratio

A useful formula put forward by the Purdue Experiment Station for 1,000 gal. (U.S.) is:

Potassium nitrate	9 lb. 3 oz.
Magnesium sulphate	2 ,, 3 ,,
Mono-ammonium phosphate	2 ,, 6 ,,

Comprising only three salts for the major nutrients. At other Stations other readily available salts are used.

Whilst in large-scale installations the fertiliser grades of mineral salts are usually employed, the use of urea-formaldehyde has been discussed by Stuart (1948) who suggested the addition of inorganic nitrate as a supplement. Florida pebble phosphatic rock of $\frac{1}{10}$ in. to $\frac{1}{2}$ in. size has been tested as a suitable aggregate.

The instructions given for the American Army stress the importance of dissolving the salts in the correct order, thus reducing precipitation. This point is applicable for both major and minor nutrients. The number of daily irrigations recommended is usually two or, in warmer countries, three, but certain crops require more frequent applications, such as cucumbers.

Experience has shown that especially for tomatoes it is well to keep the concentration of ammonia low (35 p.p.m.) and to supply the nitrogen chiefly as nitrate.

The nutrients most frequently added at weekly or monthly intervals are boron (monthly), zinc (monthly), manganese, copper and iron. The final approximate dilutions of boric acid, manganese sulphate and iron citrate (or sulphate) used, approximate to 15 p.p.m., 0.5 p.p.m., 10 to 15 p.p.m. respectively of the salts named. Less frequently it has been found expedient to spray the foliage of the plants growing in aggregate with a weak solution containing the element diagnosed to be deficient.

Sands and aggregates

Templeman (1947) pointed out that sand must have a low calcium content to prevent precipitation of phosphates from the nutrient applied to the bed. Evidence was collected by Tincker (1943) of such precipitation from the superphosphates used on the sand and gravel in the dry application methods.

In recent years use has been made of vermiculite, a grade of mica in which the laminae have been separated by the action of steam formed when the mica was rapidly heated to around 2,000° F. Mullard (1950) claims that vermiculite retains more than twice the volume of nutrients solution retained by sand. It retains about four times its own weight of water. Numerous tests in this country have given satisfactory results; in America large-scale tests have been carried out at Beltsville. A neutral grade generally is used, but some samples may, when first used, give an alkaline reaction.

Sterilisation of the concrete beds and of the channels by chemical means has been proved valuable and is usually carried out at the end of the season.

Adsorbed ions

Coleman (1942) found that clays, both kaolinite and monti-morillonite, yielded adsorbed phosphates sufficient for the growth of oats and cotton, although chemical methods using weak acids or alkali proved ineffective in extraction. Schlenker (1942) using quartz sand as a substrate supplied the nutrients in an adsorbed form on permutite or on aniline black, so supplied they proved available to the growing plants.

Arnon and Grossenbacher (1947) used synthetic resins—amberlites—as a source of adsorbed anions and cations; the technique offered possible advantages arising from the incorporation of all the nutrients at the outset of prevention of losses of nutrients by leaching, and it permitted the variance of one ion without that of its opposite charge. A phenolic formaldehyde resin permitted cation exchange, an amine formaldehyde resin anion exchange.

Water collection

For the operation of large-scale units of soilless cultivation the collection and storage of adequate supplies of water present their own problems varying with the climate, especially rainfall and temperature, the site and other factors. At some stations large surfaces have been concreted to act as catchment areas; and in certain cases small underground reservoirs have been excavated, elsewhere large steel storage tanks have frequently been erected. Distillation plants have been installed where cost was not of major importance. At Nassau a disused concrete air-runway permits the collection of 10,000 gal. (U.S.) from 16,000 sq. ft. for a rainfall of 1 in. approximately (1 acre in. of water equals 27,152 U.S. gal.).

There are many interesting features concerning the collection of fresh water on New Providence and other Bahamian Islands. The rainfall water penetrates the fissures of the calcareous surface rock and can be reached at various depths, frequently between 5 in. and 20 in. below the surface, floating on the surface of the salt water of the Caribbean which underlies the calcareous strata and moving with the tides up and down. Long trenches are mechanically cut into the chalk, usually to a depth of 8 ft., often 300 ft. in length and 200 ft. apart. In these the fresh water collects, but any fissure in the soft rock may allow salt water to pollute the area. Alternatively small bore holes of narrow diameter, in groups of three, four or five, are made to the required depth and from these the upper, fresh water is pumped by means of electric pumps. A narrow (4 in. dia.) bore well may yield fresh water for a considerable time, but constant observation and supervision of the salinity is practised. With 50 in. rainfall it appears safe to assume that one-third of the rain water reaches the water table; 1,000 gal. can be pumped from 1 acre daily for long periods with safety.

After periods of low rainfall the fresh water level may be low. Low tides add further to the difficulty as the fall in the fresh water level may lead to a higher degree of salinity, but fresh water can be found below sand dunes about 20 ft. back from high water mark on certain islands. When a well or trench once gives salty water it usually continues to do so, and very long rests of up to 10 years have proved of no avail in some cases.

Whether purification of salt water by the adsorption of the salt ions can be made an economically paying proposition yet remains to be shown for such purposes.

Rate of water consumption

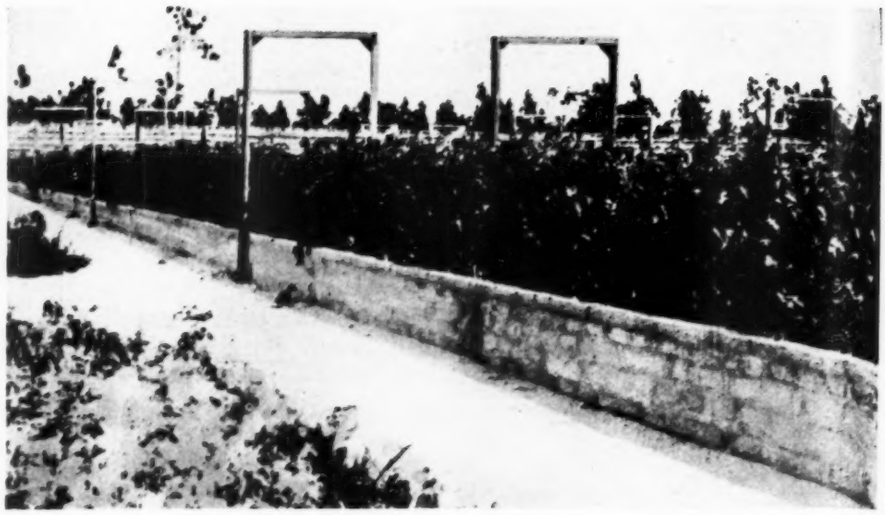
Over a period of seven years the data collected and presented by Templeman (1947) and others show that a tomato plant in sand or gravel, grown under glass in this country required from 58 to 75 gal. of water (or solution) for its seasonal growth to produce approximately 10 to 12 lb. of

fruit. This is roughly equivalent to a seasonal rate of water consumption of 310 to 350 gal. per sq. yd. of surface in the six months of the season. It represents about 72 in. of rainfall, in the half year.

Arnon and Hoagland (1940) compared the amounts of water used by tomatoes growing in sand and in water on the basis of equal fruit production and obtained results of the same order of magnitude for the two methods, emphasising that climatic conditions controlling transpiration play a determining part in governing water loss. The heating of the nutrient solutions slightly increased the water loss per unit of fruit produced.

In the open, in the Bahamas, where the shade day temperature may attain 92° F. and, despite the high relative humidity, records of the water loss have shown a daily maximum consumption of 2.2 gal. per sq. yd. for two irrigations daily. (Part of this loss is undoubtedly due to the leaks in concrete beds.) This is equivalent to about $\frac{1}{2}$ in. of rain. A similar rate of water consumption—$\frac{1}{2}$ in. rain—would be employed for one overhead irrigation of crops in soil in Great Britain and under similar climatic conditions elsewhere (Skillman, 1948) and probably would be sufficient for 10 to 14 days. At other stations, including Ascension Island, shading has been used to economise water by covering the surface of the aggregate with hessian or similar cheap fabric and allowing the plants to grow through slits cut into it and by erecting a shading canopy over the installation generally.

Some data are presented in Table 1 to show water losses observed by different workers under diverse conditions with several crops. Whereas some 58 to 75 gal. of water were needed under British greenhouse conditions for a yield of 11 lb. of tomatoes, in Nassau in the open 31 gal. were needed for 9 lb. or so of fruit. The



Tomatoes supported from wires held by frames over the beds

growing season was only approximately $\frac{3}{5}$ of the duration of that in England. With lettuce grown in winter in Great Britain one plant needed 1 gal. of water (approx.) but in Nassau required about 5.5 gal. when grown in the cooler period there. These crops received in addition the natural rainfall occurring in Nassau, but part would drain away.

Stated in other words, the provision of 85 gal. per sq. yd. represents 19 in. of rain approximately for the lettuce crop and the addition of 240 gal. for the tomato crop, another 52 in. of rain; although these two crops did not occupy the beds for 12 months, 71 in. of water was used. This is a high rate of water loss. It therefore becomes apparent that water economy is a factor of major importance in such methods of food production and could well limit the area of cultivation in special cases.

Conclusion

The quality of the produce from plants grown by soilless cultivation compares favourably with that of plants grown in soil. There are no major differences. In Japan certain human diseases may be contracted through soil organisms, and peoples and soldiers of other races have proved particularly susceptible to them. The use of vegetables grown in soilless cultivation has decreased the incidence of such troubles.

Soilless cultivation is a highly specialised means of food production suited to limited areas and specialised conditions; it requires also a fairly high degree of technical skill for its successful operation and demands not only skill in growing crops but a knowledge of plant physiology and elementary chemistry and for this technicians require training.

As in many other industries, the historic development may be traced from the laboratory phase of scientific investigations undertaken with no commercial motive, through the pilot plant tests carried out chiefly under greenhouse conditions, to the industrial scale of food production in the

TABLE 1

APPROXIMATE WATER CONSUMPTION. DIVERSE CLIMATES. VARIOUS METHODS

Observer	Method	Equipment	No. of applications	Notes on equipment	Crop	Conditions	Yields per plant, lb.	(Imp.) gal. per plant, seasonal	(Imp.) gal. per sq. yd. seasonal
Templeman, 1940-43	Surface watering	Pots, short beds	1 to 4 daily	Sand and gravel	Tomato	Glasshouse	11	58	307
Templeman and Messrs. D. Page Ltd.	Surface watering	Beds, 150 ft. x 3 ft.	2 daily	Sand and gravel	Tomato	Glasshouse	13	60	318
Templeman and Messrs. D. Page Ltd.	Surface watering	Beds, 150 ft. x 3 ft.	2 weekly	Sand and gravel	Lettuce	Winter Glasshouse unheated	96.5% good	1	18
Messrs. D. Page Ltd., 1944	Automatic dilution	Beds, 14 ft. x 3 ft. x 8 in. deep	1 daily	Sand and gravel	Tomato	Glasshouse	8	69	324
Templeman, 1944-45	Sub-irrigation	14 ft. x 3 ft. x 8 in.	3 or 4 daily	Pumped from tank	Tomato	Glasshouse	9.11	76	347
Tincker and Hicks, 1942-43	Dry application of chemicals	Beds, 100 ft. x 3 ft. x 8 in.	2 to 4 weekly		Carnations	Glasshouse	good	72	325
Arnon and Hoagland, 1940	Soil heated Unheated				Tomato	California	14.2	25.0	157
	Solution heated Unheated	Tanks				Glasshouse Feb.-Aug.	13.9 / 17.0 / 15.7	25.5 / 38.0 / 33.0	200
Johnson, 1950	Sub-irrigation	Beds	2 daily	Pumped	Tomato	Open Nassau	9	30.6	240
					Lettuce	Open Nassau	good	5.5	85

open and under glass in diverse climatic conditions. The dominant factors governing success or failure under peace-time conditions are mainly the economic conditions concerned with the costs of installation and maintenance on one hand and the marketing opportunities on the other. Amongst these factors the use of water, its collection, its quality and its consumption are of great importance and becoming increasingly so as rainfall decreases and temperature rises. Because of this the extension of the soilless method of cultivation will be limited. Under war-time or similar conditions these considerations are of secondary importance and the production of fresh vegetables may be accomplished in the most unpromising areas at high cost of labour and water collection.

Acknowledgments

Thanks are tendered to J. E. Roberts, Superintendent of Public Works, for many details regarding the water supply in the Bahamas and to the Directors of the 21st Century Corporation for permission to publish this paper.

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Award to Swedish Agricultural Counsellor

At a recent luncheon in London the Minister of Agriculture, Sir Thomas Dugdale, Bt., M.P., presented the Swedish Agricultural Counsellor, M. Miles von Wachenfelt, with the badge of Commander of the British Empire, awarded to him for his services to British agriculture.

With a 120-million dollar Marshall Plan loan Ireland has embarked on a 10-year project to reclaim 4 million fallow acres of land. Here a bulldozer levels land for future cultivation near Kilkenny, Ireland

Land Reclamation under the Marshall Plan

UNDER the Marshall Plan 11 countries in Europe and Africa have been enabled to start large-scale schemes for the reclamation of land for agriculture. The scheme is administered under the Economic Cooperation Administration (ECA).

Since the Plan began the 11 countries affected have spent the equivalent of 145 million dollars, and well over 15 million acres of new land have been brought under cultivation.

Financing this huge programme is, with few exceptions, carried out under the counterpart fund system, under which for every American dollar given to the various European nations in the Marshall Plan group, the countries themselves put up the equivalent in local currency. With the permission of ECA, these funds are then ploughed back into the recovery effort.

The total extent and size of these operations are probably not nearly so extensively appreciated as their importance deserves, and accordingly the following account of the position in the various countries involved, which has been supplied by ECA, is of considerable interest.

The countries in Europe and Africa affected by the scheme include France, Italy, Portugal, Greece, the Netherlands, Ireland, Austria, Turkey, Algeria, Tunisia, Morocco and French West Africa.

The lines of development and the progress made in each are summarised in what follows.

Greece

The problem was especially urgent in Greece where Communist influences were capitalising on a critically short food supply. Never a self-supporting country, Greece did not have sufficient productive land to feed its population. Out of a total land area of 32,500,000 acres, only 8,000,000 were arable.

In the reclamation battle, hydraulic engineers introduced flood control in an area of 580,880 acres; started draining 61 lakes and swamps and 99 wet lands for a total of 612,694 acres; and began irrigating 695,322 acres of land. More than half the projects have either been completed or are nearing completion.

Perhaps the most spectacular phase of the programme was the reclaiming of lowlands on the Aegean Sea which have lain unused from ancient times because of their salt and alkali content. A washing and draining process almost immediately made the land arable for rice production. Based on progress so far made, Greece will fill its internal rice consumption needs this year—and the crop may prove a dollar export item in the future.

Total drachma cost to date is equivalent to $23,300,000.

Netherlands

Reclamation work in the Netherlands is something the Dutch are particularly adroit in doing for they have faced the problem for more than seven centuries. During that time they have reclaimed over 2,000 square miles from the sea. The need to continue the battle today is heightened by the increased food needs of a population that is increasing by 100,000 each year.

In Holland rich farm land now stretches as far as the eye can see where once the waters of the Zuider Zee raged. This is due to the great new dykes which have been built to reclaim this fertile land from the sea. Over 5 million dollars in counterpart funds went towards this project

The present programme calls for reclaiming 480 square miles from the Zuyder Zee, which is expected to be completed within the next four or five years at a cost of 174,700,000 guilders ($49,500,000). The work is done by enclosing chunks of the sea by dykes and draining it for farm acreage. Lately, irrigation has been used to wash from arable land salt that has been seeping in from the sea.

France

Land reclamation in France is closely tied to the building of gigantic hydro-electric plants on its rivers. Through a system of dams, reservoirs and canals, thousands of parched acres are being reclaimed for agriculture. One of the most impressive is the Rhone River Development which has been compared in size to the Tennessee Valley Authority in the United States. Scheduled for completion in 1952, the project will increase crop yields in southern France fivefold.

Another project in southern France, the Rigaud Dam, will irrigate 17,500 dry acres. Through the irrigation of the Camargue Plains in the Marseilles region, 30,000 acres were reclaimed in 1950 and 65,000 more acres were made useful for rice growing at the end of 1951.

French Africa

Equally spectacular land reclamation work has been completed or is under way in the French African Territories—Tunisia, Morocco, Algeria and French West Africa.

In Tunisia a five-year plan has provided for the construction of five dams together with a widespread irrigation system. The whole future of the country depends on its water resources, for rainfall is scarce. When it does rain it comes in torrents and soil erosion then becomes a major problem. In addition, Marshall Plan grants and counterpart funds have been given to Tunisia for well-digging equipment to tap water sources far below the wastelands of the Sahara, which crowd in on the country from the south and west.

Native workers in Algeria clear erosion terraces where fruit trees will be planted every 25 yards

Water shelves have been discovered as far as 2,000 ft. below the surface on the desert borderline. Expert French and Arab well-digging teams have turned bleak, sun-baked areas into flourishing oases for human habitation and land culture. The main products of Tunis are wheat, citrus fruits and olives, with the latter considered the finest in the world.

In Morocco, perhaps the most picturesque of French African territories, an overall farm programme called for the clearing, irrigation and cultivation of 400,000 acreas of tribal lands. It is part of a four-year programme to be completed this year.

Five huge dams are scheduled for operation by the end of 1952. With accompanying reservoirs, hydro-electric plants, canals and tunnels through mountain ranges, the irrigation system will water thousands of acres of new land and save more thousands from certain destruction through drought.

Two large dams will soon irrigate vast palm grove lands in Algeria, where a soil conservation programme has also been introduced to protect 2,400,000 acres from erosion.

In French West Africa, a territory nine times the size of France, Marshall Plan counterpart funds have been used to reclaim thousands of acres from primitive life. Occupying a large place in the country's ten-year agricultural programme is the reclaiming of huge new areas in the Niger River region, 1,000 miles inland. Here the reclaimed lands are to be used for rice production.

The total amount of counterpart funds spent to date for reclamation in France and her African territories is 19,400,000,000 francs ($67,000,000).

Italy

A popular misconception of Italy is that the country has been intensely cultivated. The fact is, there are hundreds of thousands of acres in this ancient land that are undeveloped.

To bring this wasted area into production it is necessary to meet the challenge of the twin problems, hunger and overpopulation. During the Marshall Plan years, a land reclamation and irrigation programme was begun that dwarfed any-

Over 40 collective farms have been started in French Morocco and nearly 400,000 acres cleared and cultivated. Here a native clears an irrigation ditch on one of the farms

New irrigation pumps, driven by Marshall Plan-supplied tractors, are installed in fields near Menemen, Turkey

An aerial view of the dyke for the North East Polder, Holland, under construction

thing ever attempted in Italian history. A total of 240 projects was begun in 11 provinces and in Sardinia and Sicily. Most of them were 50% complete last year. Employment was stepped up, for the programme occupied 6,326,000 man-days of work. The total cost was 44,666,100,000 lire ($71,500,000).

A great part of the work consisted of draining marshlands and the lagoons on the shores of the Adriatic Sea. Programmes in the south and central parts of Italy were expected to boost food production on 8,000,000 acres. In the south alone, where there has long been a need for a better balanced diet, experts claim food production will be increased by 30%.

In the northern provinces of Lombardy, Veneto and Emilia, where over six billion lire ($9,600,000) had been spent for reclamation projects and which were all but completed, the disastrous Po River floods in November 1951 wrought vast destruction of the work.

Ireland

In Ireland, where land hunger has always dominated national history, one-third of the country is bog, forest and what is known as ' other land,' meaning ground unfit for man or beast. In a programme to extend farmlands, $104,000,000 in counterpart funds have been ear-marked for a ten-year reclamation job that will add 4,000,000 now fallow acres to productive land. This is the largest investment in the history of the country. Since the programme was launched in 1949, some 50,000 farmers have applied for loans to reclaim 530,000 acres.

Austria

While drainage and other reclamation activities have been carried on in Austria for many years, progress has been painfully slow due to the expenses involved. Through aid totalling $2,800,000 in counterpart funds, work is now underway on 24 drainage projects covering thousands of acres of marshlands.

Turkey

Modern reclamation work in Turkey is concentrated along the banks of the Kumcayi River where hitherto floods have wiped out croplands. Thanks to a $5,000,000 counterpart fund loan, the land is now being made secure for the production of cotton, grapes, wheat, sesame and tobacco.

Portugal

Irrigation and reclamation work in Portugal is concentrated in one project for which counterpart funds equivalent to $2,000,000 have been spent.

Tilgate Horticultural Station

The Research Centre of Messrs. F. W. Berk & Co.

Messrs. F. W. Berk and Co. have been the pioneers of organo mercurial compounds for the treatment of plant disease. The work carried out at their research station at Tilgate in Sussex is described.

FROM its foundation in 1870, the firm of F. W. Berk & Co. Ltd. has been closely associated with agriculture. The sulphuric acid plants erected at Stratford-by-Bow supplied the neighbouring superphosphate manufacturers with their acid. From superphosphate to potash is a short step, and early in the present century the firm became the sole distributors of potash from the famous Stassfurt deposits. The manufacture of sulphuric acid also entailed an intimate knowledge of the properties of sulphur, and yet another contact with agriculture was established.

Even before the first World War, mercury compounds were beginning to make their appearance for the control of plant diseases. The manufacture of mercury compounds being one of the firm's major interests, close observation was maintained on the possibility of using these compounds for this purpose, and this proved to be a policy that was amply justified. At the present time, mercury compounds constitute one of the major chemical groups for controlling plant diseases and pests.

This short introduction serves to show that the Berk organisation has an almost unrivalled agricultural background, with personal contacts with such pioneers as Gilbert and Lawes in England and Hiltner in Germany. This tradition is continued today and personal contact is maintained with the numerous agricultural research workers who, though their names may not yet have passed into history, are no less pioneers in the innumerable problems which still remain unsolved.

Beginnings at Tilgate

The present horticultural station at Tilgate is the successor to more modest operations at Baynards near Horsham in Sussex, where the company produces its own fillers and does much of the formulation work on its agricultural products. Even in the 1930s it was realised that whilst the chemist could determine whether the analysis of any material was correct, it required the biologist to confirm that the contents of the package would do what the label stated. Operations at Tilgate commenced in 1942, thus establishing it as one of the senior horticultural stations operated entirely by private enterprise.

Tilgate's terms of reference are: The investigation of the biological properties of the firm's products. At the present time these include preparations containing mercury, sulphur, copper, derris, pyrethrum and DDT. To this must be added various aspects of plant nutrition, for as manufacturers of magnesium sulphate and liquid fertilisers, the unsolved problems of plant nutrition are still regarded as being of the highest importance.

Until it was taken over by the firm of Berk, Tilgate was the fruit and vegetable garden of the former Tilgate manor, and the firm has taken care to preserve the traditional craftsmanship associated with such gardens. The level of cultivation is therefore very high, since significant results obtained under these conditions are considered more reliable than those obtained under imperfect or abnormal conditions of cultivation. Furthermore, natural infestations of pests and diseases are greatly preferred to any of the artificial methods.

Programme of work

The general programme of work at Tilgate falls under three headings:

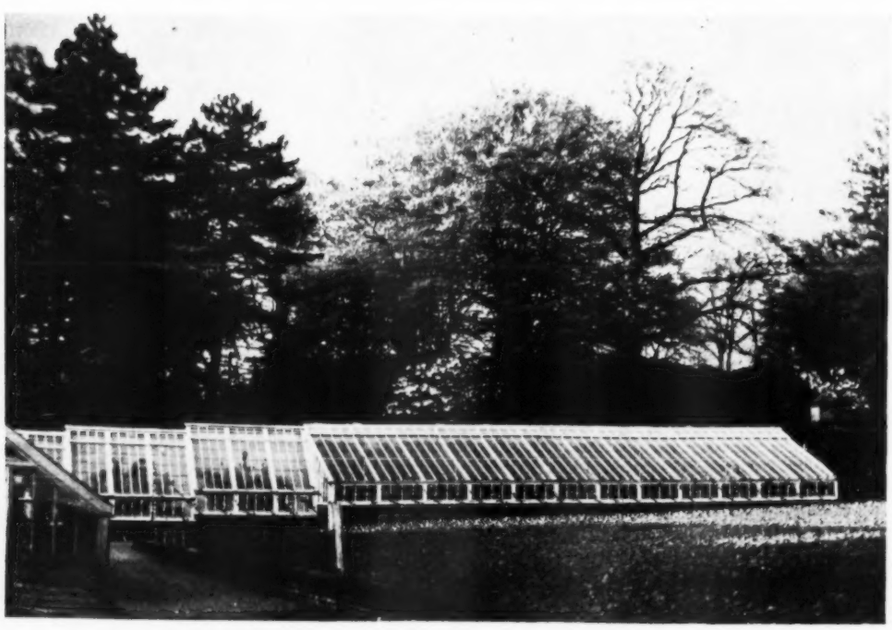
(1) The routine examination of representative samples from factory production.

(2) The use of the firm's products under practical conditions.

(3) The investigation of the properties of new substances and the application of existing substances to new uses.

Under the first two headings the major item is the work on seed disinfectants containing organo-mercury compounds, the firm being the largest manufacturers in the world of these substances. New mercury compounds are continually being put through screening tests, samples from works production are checked for performance and possible substitutes for mercury are examined, though with little success as yet.

Fundamental work on the biological properties of mercury and its compounds has been in progress for many years, and much of the published reports are based on experiments at Tilgate.[1,2] The combination of the firm's research chemists, capable of producing every known mercury compound and many unknown ones as well,



View of some of the glasshouses showing typical wooded background at Tilgate

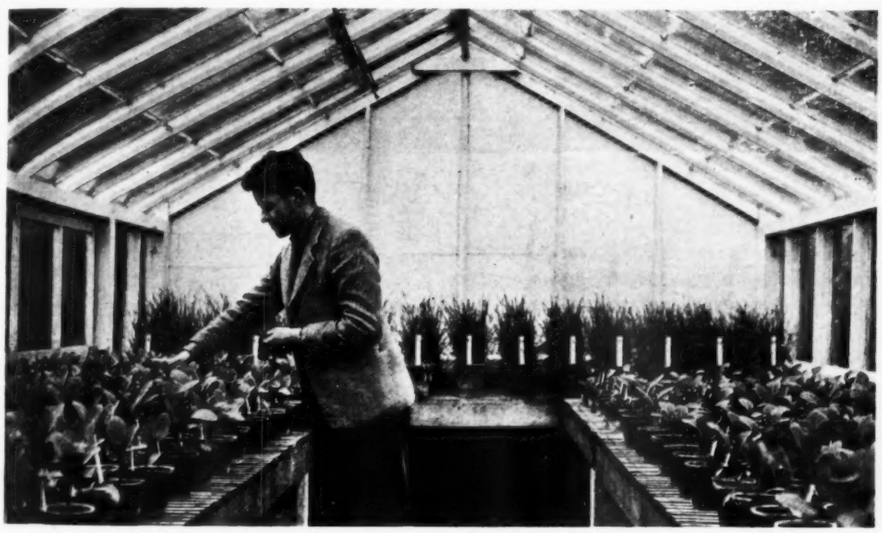
with the facilities for accurate observations on the action of these compounds on almost any plant, is ideal for the collection of the mass of data required for fundamental work.

Fundamental work

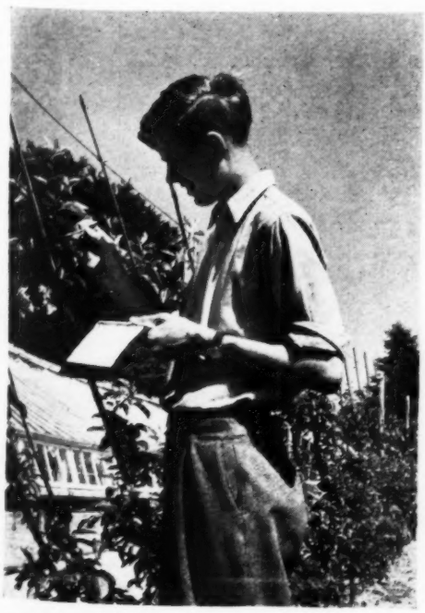
This fundamental work has already had two important practical developments. It was first observed at Tilgate that the serious disease of white rot of onions caused by the fungus *Sclerotium cepivorum* could be controlled by mercury compounds. This disease has been established for many years and was seriously menacing the onion growing districts in the West Country. Its accidental introduction into Tilgate about 1943 threatened to put onion growing out of the question, as no cultural remedy was then available. It was soon discovered, however, that the correct application of calomel (mercurous chloride) either to the seed or to the seed drill would give a high degree of control. Thus onion growing was re-established not only at Tilgate but in many districts in Worcestershire. The work on this subject that was published[3,4] has since formed the basis of the recommendations now appearing in the Ministry of Agriculture's Advisory Leaflet No. 62 (1949 edition).

A second interesting development came from the observation that the growth of moss was inhibited by the presence of mercury. This was originally noticed in small-scale pot tests on another subject. However, by gradually extending the size of the trials this casual observation resulted in the development of lawn sands and other preparations containing mercury which have been shown to give effective control of moss in lawns for at least 12 months and by annual application can keep turf permanently moss-free. Such a major alteration to the turf population appeared to be worth studying on a long-term basis—there is an element of truth in the old saying that it takes a few hundred years cutting and rolling to make a good lawn. Even after four years definite beneficial changes in the turf population can be detected as the result of annual applications of mercury compounds.

Trials on the control of apple scab; preliminary tests under glass



Conducting routine tests of works samples



Trials on the control of apple scab; field counts being made

The sulphur shortage

The present shortage of sulphur has emphasised the necessity of finding substitutes for products such as lime-sulphur and the dispersible sulphurs, and here again the organo-mercury compounds appear to be promising foliage fungicides. At the present time an exhaustive investigation on the effects of these materials on the control of the scab diseases of apples and pears is in progress and the work includes a comprehensive study on the compatability of the organo-mercury compounds with the standard fruit insecticides.

Still in the early stages is the interesting problem of replacing copper with organo-mercury compounds to combat potato blight (*Phytophthera infestans*). Preliminary trials have been promising, but more results will be available as the season advances.

The present uncertain position regarding sulphur supplies has put a damper on this section of the research programme, the search for alternatives being considered more important. Amongst recent accomplishments, however, is the development of a new type of dispersible sulphur in which the objectionable ' run-off ' effect has been almost entirely eliminated. The possibility of applying this principle to other spray products is being investigated.

Work on problems of plant nutrition is notoriously slow and unspectacular. During the war the quantitative effects of magnesium deficiency on glasshouse tomatoes was investigated. As a sequel to this work, a new study of the problem of blotchy ripening was made. Interesting results have been obtained and will be published in the near future.

Of increasing importance are the various methods of growing crops in which the soil is replaced by some inert medium such as sand or gravel, often erroneously described as ' hydroponics.' The latter is a method of growing plants with their roots immersed in water and is rarely practised except for research purposes. In commercial practice, which is more correctly described as ' soil-less culture ' and in which the nutrient solution is applied either by overhead watering or sub-irrigation, disease when it occurs is a formidable problem. Possibly due to the absence of the antibodies present in normal soil, a disease attack in soil-less culture can be devastating. Methods of combating such attacks are under investigation.

Conclusion

In view of the highly specialised work which is proceeding at Tilgate it is not surprising that there should be a large number of visitors. The officers of the National Agricultural Advisory Service are frequent and welcome visitors and organised parties from such distinguished bodies as the National Farmers Union, the Horticultural Education Association, Society of Chemical Industry and numerous local horticultural societies are annual visitors. To cater for these demonstration plots are maintained showing the effects of the diseases which are prevalent at the Station and the results of controlling them by chemical and other means.

Quite apart from the scientific work in progress there, Tilgate itself is indeed a pleasant place. Located in the midst of charming wooded country in the typically English surround of the Sussex countryside, the peaceful charm of rural England is the predominating atmosphere. Here may be seen many examples of English gardencraft in their choicest forms. The firm of F. W. Berk consider it to be a privilege that they are able to maintain one aspect at least of the gracious old-time days which are now so rapidly being lost to view.

Sub-irrigation equipment at Tilgate

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Examples of seed dressing trials on cereals

Israel's Unirrigated Crops

The cultivation of 40,000 dunams (10,000 acres) of unirrigated land is beginning to get under way as a result of agreements between the Ministry of Agriculture and some 125 villages in various parts of Israel. All but the most essential public works have been stopped and most of the workers will be absorbed in the present scheme, citrus picking in the south or in afforestation projects in the north.

Cultivation by hand represents a new departure in Jewish farming methods and is designed to increase food production with the minimum outlay of foreign currency.

Sugar beet will form one of the main winter crops. Experimental cultivation of beet under irrigation has been highly successful and 10,000 dunams are being grown without irrigation this winter. It is hoped that in a few years 100,000 dunams will be put under beet to supply all local sugar requirements. Two sugar refineries, now being built, will begin production in 1953. Meanwhile, the crop will be used in manufacturing alcohol and the pulp used for cattle fodder. Other winter crops will be onions and legumes, particularly important items in the diet of oriental immigrants.

Tobacco will be grown all year round and it is hoped to meet all the local demand for Turkish tobacco through the project, though Virginia leaf is still being grown under irrigation. Tomatoes and other vegetables will be planted in the spring and next year, it is hoped, potatoes.

American Fertiliser Practice and Problems

E. M. CROWTHER, D.Sc., F.R.I.C.
Rothamsted Experimental Station

In a paper recently read before the British Fertiliser Society, Dr. E. M. Crowther reviewed his impressions of the fertiliser position in the U.S.A., based upon knowledge gained during a tour in that country. We reproduce below a condensed version of the paper.

IN the spring of 1951 I was able, with the assistance of the Economic Co-operation Administration and the Agricultural Research Council, to spend nearly three months in the United States studying research in soil fertility problems and recent developments in the use of fertilisers.

The Americans have a low density of population and, therefore, emphasise 'output per man'; we still think of 'output per acre.' In soils and fertilisers there are similar contrasts. Britain must import all its phosphate rock, its potassium salts and most of its sulphur and pyrites, but the United States is self-supporting for all of these materials. In Britain the neutral or slightly acid soils of the East have been manured more heavily than the acid soils of the West and North, whereas in the United States fertiliser practice has long been firmly established on the poor acid soils of the East and is only recently being extended to the slightly acid or alkaline soils of the Mid-West and West.

FERTILISER CONSUMPTION IN THE UNITED STATES

	Thousand short tons			$N + P_2O_5 + K_2O$ *as* % *of fertiliser*
	N	P_2O_5	K_2O	
1900	62	246	86	14.5
1910	146	499	211	15.4
1920	228	660	258	15.7
1930	377	793	354	18.1
1940	419	752	435	19.7
1949-50	1,005	2,292	1,105	24.0

In 1949-50 the United States used just over one million tons N, two million tons P_2O_5 and one million tons K_2O. The ratio $N : P_2O_5 : K_2O$ was about 1 : 4 : 1 in 1900; it had changed to around 1 : 2 : 1 by about 1930 and this ratio was maintained until about 1945. The proportion of phosphate increased for the first few years after the war, but during the last two or three years the old ratio 1 : 2 : 1 has returned.

Climates, soils and farming systems vary markedly throughout the United States and, to obtain useful impressions, it is necessary to divide the country into regions. In the U.S. Department of Agriculture fertiliser statistics, the 48 States are divided into nine regions.

Since the earliest days sodium nitrate and other fertilisers have been used very heavily in the South Eastern States. As recently as 1920 well over half of the total tonnage went to the South Atlantic Region; it now takes only a quarter of the total. Consumption in the Pacific Region went up 20 times in this period. Until comparatively recently the bulk of American fertilisers were used on acid soils, but the increasing demand for fertilisers on neutral and alkaline soils raises new problems.

Thus, the East North Central Region uses a low proportion of nitrogen, and the Pacific Region (especially California) a high proportion. The ratio $K_2O : P_2O_5$ is higher in the Eastern than in the Western Regions.

The general level of manuring and the kinds of fertiliser depend on the intensity of farming. Where there are favourable conditions of climate, irrigation or marketing, land can be farmed intensively on inherently poor soils, provided they are well fertilised. Thus the States of Florida, California, Arizona, New Jersey and North Carolina provide examples of intensive arable cropping with heavy use of nitrogen fertilisers on soils of low organic content. By contrast, the rich chernozem soils in the Middle West are farmed extensively with little fertiliser, because the rainfall is low and uncertain.

Principal kinds of fertilisers

For materials applied as such, ammonium nitrate supplies nearly four times as much nitrogen as ammonium sulphate. More nitrogen is applied to the land as anhydrous ammonia than as straight ammonium sulphate.

There are several promising new materials. Of these liquid phosphoric acid applied in irrigation water or injected directly into calcareous soils reached 6,900 tons. There were 16,000 tons of fused tricalcium phosphate, 10,000 tons of calcium metaphosphate and 18,000 tons of urea.

Nitrogen fertilisers

In the North East the bulk of the nitrogen is applied in commercial mixtures and the remainder almost entirely as ammonium nitrate. In the South Atlantic Region over half the nitrogen applied separately is in the form of sodium nitrate. Half the ammonium sulphate applied separately is used in California.

The contrasts between the use of sodium nitrate on the leached acid soils of the South Atlantic and of ammonium sulphate

Phosphate rock becomes plant food in one of the electric furnaces at Muscle Shoals, a T.V.A. project

in the arid areas of California suggests that these fertilisers have been selected for their secondary effects on the base status of the soils. Sodium nitrate reduces soil acidity and ammonium sulphate increases it.

I think that in Britain we have paid insufficient attention to the acidifying effect of ammonium salts.

Ammonium nitrate

Perhaps the biggest American challenge to our accepted ideas about fertilisers is the widespread use of ammonium nitrate. This is mainly in the form of slightly porous granules or ' prills ', coated with resin and kieselguhr, but the Tennessee Valley Authority has recently introduced a new form consisting of rounded crystals prepared by vacuum evaporation of aqueous solutions and needing only a light dusting of talc or a similar inert material. I was told that there was no special difficulty in handling the prilled material, but that the compact crystals became ' mushy ' more quickly. The fact that ammonium nitrate is used on such a large number of farms must raise doubts whether this material is really as objectionable or as dangerous as is often asserted in this country.

Anhydrous ammonia

Anhydrous ammonia is used as a fertiliser in two ways ; in irrigation water in the West and by injection into the soil, especially in the Southern States. Ammonia is, of course, the cheapest and most concentrated form at the factory. This led to the use of ' nitrogen solutions ' (ammonium nitrate or urea dissolved in ammonia) for ammoniating superphosphate. An obvious extension was to inject ammonia into irrigation water and it was also a fairly easy step to put anhydrous ammonia in tanks and allow it to escape through coulters a few inches below the soil surface. Experiments showed that the method was very efficient.

In 1948-49 the State of Mississippi used 81,000 tons of nitrogen, of which 30,000 tons were as anhydrous ammonia. About 1,000,000 acres received anhydrous ammonia at rates of about 50 lb. N per acre. It is said that 3,000 farmers have now had several years' experience with anhydrous ammonia.

What are the prospects of using anhydrous ammonia directly in the United Kingdom ? Clearly more stringent regulations, the high capital investment required and the seasonal demand present serious obstacles. We have no very widely spaced crops requiring localised nitrogen dressings. Yet the use of anhydrous ammonia or concentrated ammonia solutions should not be ruled out.

The prospects may be better in the tropics and sub-tropics, especially in the large irrigation schemes of Egypt, the Sudan and Pakistan.

Phosphate fertilisers

Superphosphate is the principal phosphate fertiliser and a good deal of it is now granulated.

Since the American manufacturer sells so-called ' available phosphoric acid ' (*i.e.*, total minus citrate-insoluble P_2O_5) he need not acidulate so fully as British manufacturers, who are credited only with the water-soluble form. He can also add about 1% calcium oxide or other basic material to reduce bag-rot.

Just over a quarter of a million tons of triple superphosphate are used annually. The development of triple superphosphate has been stimulated by high costs of transporting raw materials and products. Phosphoric acid for making triple superphosphate is prepared by the sulphuric acid method at several factories and through electric-furnace phosphorus by the Tennessee Valley Authority.

T.V.A. has also developed a process in which burning phosphorus reacts with phosphate rock to give a calcium metaphosphate glass. It also produces defluorinated phosphate rock or fused tricalcium phosphate. There is much interest in the possibility of fusing phosphate rock with suitable silicates and rapidly cooling the melt.

The United States have relatively little basic slag apart from some rather low-grade material from open-hearth steel works at Birmingham, Alabama.

Finally, I come to the old problem of using finely ground rock of phosphate. The story of the use of ground phosphate rock is of interest in showing how the influence of one man can determine agricultural practices long after his death. The late Professor Cyril G. Hopkins, of Illinois University, was a powerful advocate of a system of permanent agriculture based on using finely ground phosphate rock on prairie soils. His methods are still practised in Illinois and some of the neighbouring States. In 1949-50 the State of Illinois used three-quarters of its P_2O_5 in the form of ground rock phosphate. This accounted for more than half of the total amount of untreated rock phosphate used in the whole of the United States.

Potassium fertilisers

These need little comment. The United States is self-supporting. Through the development of ingenious methods of concentrating potassium salts from low grade ores, it is now possible to supply 50% and 60% salts as relatively coarse crystals. To the field experimenter, who must often apply potassium salts apart from other fertilisers to some farmers and to all fertiliser mixers, these coarse products would prove far more convenient than the fine damp forms with which we are only too familiar in this country.

Other elements

Magnesium is used as dolomitic limestone, both as a liming material and as a common ingredient of mixed fertilisers. It

The original fertiliser attachment for placing fertilisers in a band on the plough sole, developed at the Purdue University Experiment Station, U.S.A.

A truck fitted with spreading attachment distributes ground limestone on a Philadelphia farm

is also possible to obtain mixtures of potassium and magnesium sulphate. Borax is used a good deal for lucerne and sugar beet.

The use of many elements as fertiliser ingredients and sprays is highly developed in some areas of intensive market gardening, especially in Florida. Here, on soils containing little beyond quartz, special mixtures are made up for each farm in terms of findings by leaf symptoms and analysis.

Mixed fertilisers

In the early days the bulk of the nitrogen in commercial fertiliser mixtures was derived from such organic wastes as cotton-seed, fish scrap and tankage. As late as 1913 over 40% of the nitrogen in American mixed fertilisers was from organic sources. The proportion fell rapidly between the two wars through the increasing demand for fertilisers. The problem of maintaining good physical condition in mixtures containing large proportions of soluble salts had to be solved. Different approaches have been made in the United Kingdom and the United States. Here we have granulated our mixtures to retain a high proportion of water-soluble phosphate. The Americans granulate a good deal of their superphosphate but only a small proportion of the mixtures are derived from superphosphate. Instead they have adopted the practice of ammoniating the mixtures with solutions containing ammonia and either urea or ammonium nitrate. In this way they are able to use the cheapest forms of nitrogen.

Neutralising the free acid with ammonia allows the incorporation of ammonium nitrate or urea and also allows the use of dolomite as a filler to offset the acidifying effect of ammonium salts on the soil.

The ammonium citrate test

As long ago as 1884 the Association of Official Agricultural Chemists adopted a modification of the Fresenius, Neubauer and Luck ammonium citrate method for evaluating superphosphates. The original ammonium citrate method prescribed that 2 g. of the fertiliser should be extracted first by leaching with water and then with 100 ml. of a neutral ammonium citrate solution at 65° for 30 min. When dicalcium phosphate was introduced, the simple modification of taking 1 g. of this material instead of 2 g. was adopted. When ammoniation was introduced, investigation led to adoption of a modification by which the residue from 1 g. fertiliser, after leaching with water, is extracted with ammonium citrate at 65° for one hour. This method shows little change in the citrate-insoluble P_2O_5 as the amount of ammonia added to superphosphate is increased up to about 2.5% NH_3. Manufacturers normally endeavour to obtain the largest amount of so-called ' available phosphoric acid ' (*i.e.*, total P_2O_5 minus citrate-insoluble) but it sometimes pays them to ammoniate very heavily where ammonia nitrogen is much cheaper than that in ammonium nitrate or sulphate.

The British Productivity Team on Superphosphate and Compound Fertilisers noted that 'the Americans have a considerable advantage over the industry in Great Britain as their legislation does not confine them to water-soluble phosphate guarantees and so permits the complete neutralisation of any free acid '. They suggest that ' strong recommendations should be made to the appropriate authorities to adopt the available phosphoric acid standard in preference to the water-soluble standard as soon as possible '.

Since the ammonium citrate method was changed to fit ammoniated superphosphate, it has been found to serve fairly well for many of the new kinds of high-temperature phosphates and within the last year or so it has also been adopted for basic slags. There is now a single legal definition for ' available phosphoric acid ' in the United States. W. B. Andrews has given results of field experiments in which heavily ammoniated superphosphate containing dolomite were markedly inferior to mixtures containing water-soluble phosphates. It seems likely that increasing emphasis will be laid on maintaining at least moderately high water-soluble P_2O_5 contents on products derived from superphosphate. I venture to assert that within a dozen years or so a water-solubility test will be introduced into some parts of the United States.

Some experienced fertiliser chemists urged me to press strongly for retaining the water-solubility test in the United Kingdom, in addition to any alternative analytical method. No promising fertiliser, such as ammoniated superphosphate, dicalcium phosphate or ' nitrophosphate,' should be penalised through the lack of an appropriate test to fit it into the price structure. On the other hand, one should not abandon a well-established and critical test for our main fertilisers, merely to accommodate new products.

Nitrophosphate fertilisers

The sulphur shortage has given a new impetus to research on methods for making mixed fertilisers without using sulphuric acid. The Tennessee Valley Authority have developed on the pilot-plant scale a variety of ' nitrophosphate ' fertilisers based on treating phosphate rock with nitric acid and then ammoniating to produce mixtures of dicalcium phosphate and ammonium nitrate. T.V.A. has the advantage of being able to include mixtures of phosphoric and nitric acids. This allowed them to make a variety of products, including some with high proportions of water-soluble phosphoric acid. The nitrophosphates were fully as effective as mixtures based on triple superphosphate on acid soils, but somewhat less effective on neutral soils.

The prospects for ' nitrophosphates ' would be favourable if it should prove possible to prepare nitric acid by the direct combustion of air, as is being attempted by the Food and Machinery Corporation.

Fertiliser supplies and prices

The general structure of the fertiliser industry in the United States has much in common with our own, but there are some important differences. There are a few very large manufacturers, some owning phosphate deposits, and a vast number of small mixers, some financed by farmers' co-operatives.

A number of studies have been made on the relationship between farm incomes and expenditures for fertilisers. From 1880 to 1943 the total annual expenditure on fertilisers averaged 2.3% of the farmers' gross income in the previous year. The expenditure has increased in recent years, corresponding figures being 2.7% for 1911 to 1943 and 3.8% for 1930 to 1947. The percentage varies widely between regions. Over the period 1925 to 1943 the percentage of the previous year's gross income spent on fertilisers was 14 in the South Atlantic states, 5 in the New England states and 1.6 in the mid-west.

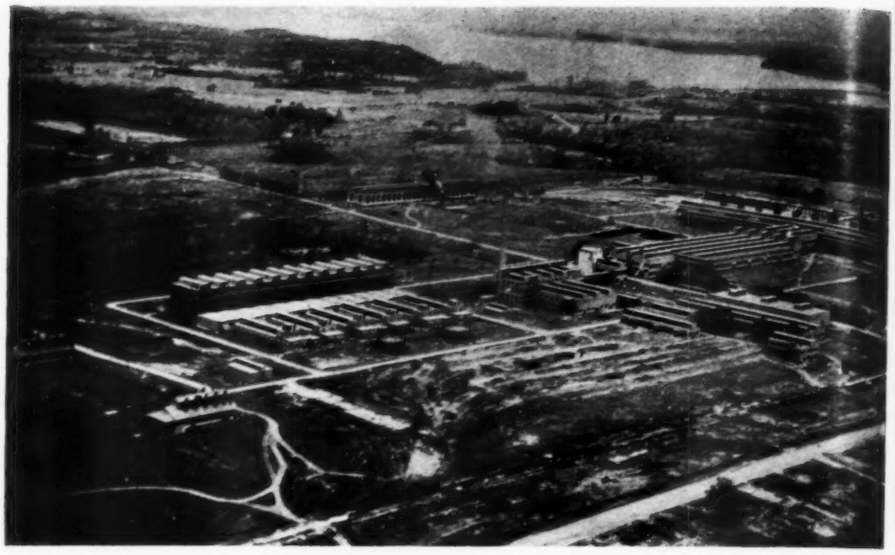
Since about 1933 the federal authorities have encouraged the use of fertilisers in special areas by subsidies or free supplies. Thus, in some regions the Production and Marketing Administration makes 'agricultural conservation payments' for fertilisers, limestone, pasture improvement, contour farming and making grassed waterways. When the Tennessee Valley introduced its system of 'test demonstration farms' free phosphate fertiliser was supplied to selected farmers who undertook to manage their farms on approved lines. This enabled the Tennessee Valley Authority to make good use of large quantities of new kinds of phosphate fertiliser and to transform a depressed countryside into a prosperous and progressive one. The free issue of phosphate fertiliser is now being limited to special watershed areas and the bulk of T.V.A.'s output is to be sold.

General publicity and educational work on fertilisers is undertaken by two associations and the Plant Food Council. By American Law these organisations are precluded from making trading agreements or fixing prices.

Fertiliser control

Each state works its own fertiliser laws, through the State Department of Agriculture. Fertilisers must be registered and approved before they can be sold. Fees are charged in most states for the registration, with an additional inspection fee to cover the cost of analysis and administration. A few states require a statement of the sources from which the nitrogen, phosphoric acid and potash are derived. Fertiliser terms are generally framed to define the grade. Thus for superphosphate 'the grade that shows the available phosphoric acid shall be used as a prefix to the name. Example: 20% superphosphate.' Samples are drawn officially after the products have left the factory. Analytical results are published and penalties are exacted for deficiencies and paid over to the user. North Carolina uses its Fertiliser Control to advance agricultural investigations and education.

I understand that all courts accept analyses by the method of the Association of Official Agricultural Chemists. I think that the American system of fertiliser control has great advantages over ours. The British method of distinguishing between civil and criminal codes needs elaborate precautions. The American system is worked systematically, which is more than can be claimed for ours, and the definition of fertiliser names in terms of grades removes ambiguities.



The Tennessee Valley Authority nitrate plant No. 2 at Muscle Shoals, Alabama. In conjunction with the nitrate plant a demonstration fertiliser plant has been built for the production of low-cost superphosphate

The application of fertilisers

The design of implements for American farms has been profoundly influenced by two facts. Spring comes very rapidly with a short and critical period for preparing land and sowing crops. The two most heavily manured crops are cotton and maize, both of which are grown in widely spaced rows, 36 to 40 in. apart. Implements designed for these crops have been applied to other crops, and even potatoes are grown at these spacings. It would be obvious to observant farmers that fertilisers should be placed close to the seeds or young plants and not dissipated over the whole of the soil between the wide rows. Special fertiliser distributors were designed to place fertilisers in bands close to the seeds, but not near enough to check the germination of sensitive crops. For cereals, time could be saved by sowing seed and fertiliser down the same spout. These methods reached Britain very late, mainly because we grow no widely spaced farm crops.

Excellent work has been done by the National Joint Committee on Fertiliser Application on a wide range of crops, and its general recommendations have been widely circulated in a bulletin, 'Methods of Applying Fertilisers.' The last annual volume gives an impressive array of distributors designed for special experimental purposes.

Photos: U.S.I.S., London

'Food Manufacture's' Silver Jubilee

The June issue of our contemporary, *Food Manufacture*, represents a landmark in its history inasmuch as it is its Silver Jubilee number.

To commemorate this event the issue has been considerably enlarged and will include a series of concise resumes of progress in various sections of the food industry during the past 25 years and discussions of some of the more salient problems which the industry faces today.

The authors of articles in this issue include some specialists who contributed to the early numbers of the publication and who have in the interval been actively engaged in their own branch of the food industry and are still so occupied.

This special issue will no doubt prove worthy of being preserved as a record and for reference purposes.

NEW BOOKS

The Geography of Hunger

By Josue de Castro. Pp. 228. Victor Gollancz, 1952, 18s.

Few men can have had their theories and teaching so widely criticised and assailed as Thomas Robert Malthus, the author of the celebrated 'Essay on Population,' which first saw the light of day in 1798. Time and again during the 19th century did various critics triumphantly claim to have demolished his arguments. A hundred years ago, in 1851, the time of the Great Exhibition, the expanding world economy led many to proclaim that the ghost of this aimiable economist had been effectually and permanently laid. Nevertheless, in the intervening period the theories of Malthus have again and again risen from the neat and tidy graves provided by their critics and stalked the earth with renewed vigour. Especially of recent years have they been used to support the opinions of many who view with alarm the tendency of human populations to outstrip the rate at which food supplies augment.

The anti-Malthusians receive trenchant support in this book from the pen of Dr. Josue de Castro, Director of the Instituto de Nutricao of the University of Brazil and recently elected Chairman of the Council of FAO in succession to Lord Bruce of Melbourne. Dr. de Castro claims that hunger is the cause and not the result of population problems. Hunger it appears stimulates the reproductive powers of the human race, and the remedy is not to attempt to check population increase but to stimulate production of food to provide for the proper feeding of the increasing millions. Once this has been achieved it would appear that their rate of reproduction will automatically fall and a satisfactory balance between populations and food supplies supervene. Apparently the fact that improved nutritional standards usually go hand in hand with better education and increased intelligence and that educated people more willingly avail themselves of modern contraceptive methods to check unwanted population increase has no bearing.

In fact, the rapid increases of population which have followed European penetration in many parts of the tropical and subtropical world such as India, parts of Africa and, one supposes also, Indonesia, are due, according to Dr. de Castro, not to European influence having raised the standard of living, reduced the incidence of disease, stopped inter-tribal warfare and increased the general security of life and property (though it may have mitigated the incidence of famine), but to the fact that it has produced widespread and general malnutrition and under-nutrition among primitive peoples.

Under the stress of the copulative urge engendered by chronic hunger these people have responded by producing the enormous and growing increases of population which are such a disturbing feature today.

It is an interesting theory, but one is impelled to wonder whether in spite of the impressive argumentation of Dr. de Castro the neo-Malthusians may not once again reassert themselves.

According to Dr. de Castro, the main cause of the malnutrition which is so widespread in the tropical regions is the urge to produce cash crops for export fostered by European colonising powers and particularly the development of the plantation system. While no one would deny that plantation development has tended to produce an unbalanced system of agriculture, the demand for materials such as tea, coffee, cocoa, rubber and cotton, which can only be produced under tropical conditions, is a normal and natural thing which has long existed and is bound to continue to increase. The encouragement of the production of these materials, be it by plantation enterprise or by the development of native production can hardly be regarded as reprehensible. It may well be that mistakes were made, that is hardly surprising in view of the lack of experience of the special requirements of tropical conditions. In any event knowledge of the nutritional deficiencies on which the author lays such great stress is itself of very recent growth and the need is for the development of satisfactory methods of overcoming these defects and deficiencies, and applying the new knowledge in practice as speedily as possible.

Dr. de Castro lays great stress on what he terms 'the destructive fury of the European throughout the ages,' and the English are, in his view, the worst offenders. Some of the examples he quotes are somewhat surprising, thus speaking of India he refers to the efforts of the English 'to bar the Indian masses from education' (p. 160). Speaking of English intervention in the economy of Egypt he claims that the construction of the Aswan dam reacted disastrously on the Egyptian peasant and marked the beginning of the dependence of the fellah on a complex of British commercial interests that were to alter his way of life completely. In the Gold Coast it is stated that, 'the cocoa plantations by reducing regional food production are harmful to the native, while they also ruin the soils by inviting erosion' (p. 187).

In regard to remedial measures, which are treated in the last 25 pages of the book, Dr. de Castro is, to say the least of it, somewhat disappointing, contenting himself for the most part with advocacy of the methods which are today accepted as standard and being practised in many parts of the world. Methods which the British, for example, have endeavoured to develop for the past 50 years and which underlie the work of ECA. Of the difficulties of inducing reluctant and backward administrations to adopt and consistently follow these measures he has but little to say. It is, however, interesting to observe that five pages of this section are given up to an examination and exposition of the views of the late Sir Albert Howard and his followers.

The books certainly does, as the dust cover asserts, attempt to describe the problem of world hunger in more horrifying terms than it has ever been stated before. Whether this is an entirely desirable effort seems to the reviewer to be open to doubt, being given that more balanced and more temperate expositions of the problem in this regard are abundantly available; particularly does it seem doubtful whether it is in fact wise and politic to attempt, as the book does, to ascribe a major share of the responsibility of the present admittedly unsatisfactory state of affairs to one particular nation, especially on premises of dubious validity.

H.T.

Farmer's Handbook

Compiled by W. E. Ripper, A. L. Abel, R. M. Greenslade, S. G. Jary and R. W. Shorrock. Pp. 104. Pest Control Ltd., Tenth Edition, 1952.

The tenth edition of this handbook is, like its predecessors, filled with valuable information.

As pointed out in the foreword, the rapid development of knowledge during the past two years has made it possible to extend considerably the information given in the preceding edition.

In the earlier sections of the handbook an outline indication is given of the manner in which operations for the control of pests, diseases and weeds fit into the general framework of farming. This is followed by a description of the research organisation of Pest Control Ltd.

The later sections are devoted to the consideration of the practical control of a large number of pests and diseases, with information about machines, spray chemicals, weed control and so forth. A special section deals with precautions when handling dangerous chemicals.

CORRESPONDENCE

Kenaf and Roselle

TO THE EDITOR

Sir,

The article concerning Roselle in the February 1952 issue of WORLD CROPS by A. E. Haarer is most interesting, but is not correct as regards the inference that Roselle might be superior to Kenaf, although this plant does warrant investigation.

It so happens that I carried out some of the earlier work with *Hibiscus sabdariffa* and *Hibiscus cannabinus* in Alabama with Dr. D. R. Ergle mentioned in the article's references. In addition I have just returned from a two months' fibre investigation survey in Papua and New Guinea, having carried out this work at the invitation of the Australian Department of Territories.

Whilst in New Guinea there was occasion to observe growth of several types of Roselle, including some from Java, in comparison with Kenaf on varying soil types where the rainfall ranged from 45 to 140 in. per annum, the latitude from 4½° to 9½° and the elevation from sea level to 1,800 ft. Certain conclusions were reached which indicated Kenaf to be far superior, such as:

1. Roselle generally produces a coarser stem which is unsatisfactory for mechanical decortication.

2. The plant tends to branch badly even though closely planted.

3. Roselle tends to lodge badly, which would make mechanical harvesting impossible.

4. The plant generally has a lower fibre yield than Kenaf, either from mechanical decortication or from hand stripped retted ribbons.

5. Roselle is generally slower in growth with a consequently lower fibre yield.

6. Roselle seed pods tend to shatter badly, giving a lower seed yield.

7. The fibre of Roselle is usually poorer in colour and coarser than Kenaf.

These are just a number of conclusions reached, based on observations in Papua and New Guinea, and substantiates earlier work carried out in Alabama during 1944.

One is led to believe that Kenaf when properly mechanically decorticated is an excellent, if not superior substitute for jute, as has been borne out in numerous tests. It apparently has great possibilities in areas where growing conditions are suitable and where labour costs are low.

Very truly yours,

J. M. DEMPSEY,

March 25, 1952.

Newport Industries Inc., Florida.

The writer of the article replies as follows:

TO THE EDITOR

Sir,

I thank you for perusal of Mr. J. M. Dempsey's interesting letter and I would like to take his points one by one.

1. The *altissima* variety of the Roselle has indeed a coarser stem. I understand that British interests do not, in general, believe in mechanical decortication for several reasons, the most important being the difficulty in coping with a large field at the critical time of harvest with machinery that would necessarily be idle for the remainder of the year. The inclusion of retting by modern methods is the alternative, using dried bark ribbons. In such a case the objection does not arise.

2. This is so with many varieties of the ordinary Roselle, but not surely with the Javan *altissima* varieties.

3. So does Kenaf also lodge sometimes. The *altissima* varieties of the Roselle with their stouter and coarser stems should not lodge so badly. In both cases the cure is shelter from strong wind.

4. According to all Dutch reports the yields from the best varieties of Roselle are greater than Kenaf in those areas suited to the Roselle but unsuited to Kenaf, where rainfall is heavy and the atmosphere very humid. It is the reason why they abandoned Kenaf in Java in favour of the Roselle in spite of the danger of root-rot diseases. Their material was all retted, however, and there is often wastage during mechanical decortication, which would naturally be greater with a coarser stem.

5. Roselle is indeed slower and requires more rainfall.

6. This is an interesting point. Seed might also be difficult to gather without wastage from the taller growth.

7. The Dutch, who planted the Roselle in Java in preference to Kenaf, usually state that the reverse is the case.

My articles on both Kenaf and the Roselle clearly stated that Kenaf would normally be the better fibre to grow in most situations and I inferred only that the Roselle might be found the correct choice in those warmer wetter areas unsuited to Kenaf. I did not, and never have, inferred that the Roselle might be superior to Kenaf, as is stated in Mr. Dempsey's first paragraph; see the article on the Roselle in WORLD CROPS mentioned by Mr. Dempsey, the last paragraph on page 70.

Yours faithfully,

A. E. HAARER.

Sussex. *April* 7, 1952.

Virus Decline Disease

TO THE EDITOR

Sir,

In a recent article in WORLD CROPS, 'Virus Decline Disease of Citrus,' by A. F. Posnette, **4**, 2, 64, 1952, it is stated that '*The West Indies also seems to be free from this disease, although it seems possible that the decline in limes there is due to a similar virus. The writer has seen leaf symptoms in limes in Trinidad closely resembling those caused by the virus in the Gold Coast.*'

With regard to the last sentence, which may well cause alarm if read by West Indian lime planters, I think the writer's memory may have played him false. The vein clearing symptoms of the virus on limes in the Gold Coast, figured in the article, are not seen in the West Indies nor, for that matter, is the wood pitting so characteristic of the tristeza disease, and tristeza susceptible budded combinations, notably oranges and grapefruit on sour stocks, continue to thrive in the Caribbean. The chlorotic leaf pattern most commonly seen on limes in Trinidad is that normally associated with manganese deficiency, which is quite distinct from the vein clearing figured in association with the virus.

The seedling lime disease of the West Indies is still the subject of investigation and its cause remains uncertain, but it seems undesirable to suggest the presence in the West Indies of a virus similar to tristeza in the absence of more definite evidence.

Yours faithfully,

C. HOLMAN B. WILLIAMS.

March 22, 1952.

Agricultural Department,
Trinidad.

Cereals Conference in Edinburgh

Under the auspices of the Food and Agriculture Groups, and in association with the Scottish sections of the British Society of Chemical Industry, a joint conference was held in the Assembly Rooms, Edinburgh, on May 8-10 on 'The Quality of Cereals and their Industrial Uses.' We hope to include an account of its proceedings in our next issue.

McGraw-Hill Move

We are informed that the London office of the McGraw-Hill Publishing Co. Ltd. have obtained new premises at 95 Farringdon Street, E.C.4, just off Ludgate Circus. The building is to be renamed 'McGraw-Hill House.'

It is expected that the removal of all departments from the present offices should be completed by the end of May.

India's Great Project—The Sindri Fertiliser Factory

1,000 Tons of Sulphate of Ammonia Per Day

SIX years ago Sindri was a small Indian village which could hardly be found on the map, situated on the banks of the Damodar River about 14 miles downstream from Dhanbad in the Province of Bihar. Today the huge fertiliser factory housing 45,000 tons of plant and producing 1,000 tons of ammonium sulphate and 300 tons of cement a day stands on the banks of the river.

Prior to the war, and to some extent during the war years, India imported artificial fertilisers in considerable quantities. With the world shortage of fertilisers and also of shipping space after the war it became expedient to consider the indigenous production of artificial fertilisers, which would also—and this was very important—lay the foundations for a heavy chemical industry in India.

Start of the project

During the war it was known that India would require in the future 2-3 million tons of artificial fertiliser per annum and it was recommended that the production of nitrogenous fertilisers be started to the tune of 350,000 tons. In 1944, at the request of the Indian Government, a two-man technical mission from the U.K. arrived in India to advise on the best methods of establishing a fertiliser industry. Briefly, they recommended the setting up of one large factory for the production of ammonium sulphate by the gypsum process, suggesting two alternative sites; these were Harduaganj, near Aligarh, and Sindri, near Calcutta.

It was eventually decided that the factory should be established at Sindri and a Mission was sent to the U.K. to investigate the question of supply of plant and machinery. A firm of American experts was employed as engineers to prepare designs for the complete factory, supervise its construction and see it into production. A British firm of chemical plant manufacturers was employed to supply certain specialist plant and to act as agents to the Government of India in the procurement of the remaining plant required for the factory and as constructors to erect the same under the supervision of the engineers' experts. The agreements between these two firms and the Central Government were signed in February 1946 and June 1947 respectively.

To ensure that the requisite 12 million gallons of water per day would be available for the fertiliser factory a barrage on the Gowai River (a tributary of the Damodar River) was constructed, thus creating an artificial lake holding 800-1,000 million gal. of water. An infiltration gallery was also constructed to tap the water available in the sand in the Damodar bed when the surface supply diminishes.

General view of the synthesis section at Sindri; the two Horton spheres are 45 ft. 8 in. in internal diameter with $\frac{7}{8}$ in. thick walls

The factory has its own power station because a vast amount of low pressure steam is needed for process work and economic production requires that this steam should first pass through turbines for the generation of electricity. Capacity of the factory power house is 80,000 kW., 20,000 kW. more than is required by the factory in order to supply power in bulk to the Bihar grid.

By-product utilisation

Some 900 tons of calcium carbonate sludge are thrown up daily as a by-product of the manufacture of 1,000 tons of ammonium sulphate when the factory is in full production and plans for the construction of a cement factory capable of producing 600 tons of cement daily have been drawn up.

Although original plans involved the extraction of gypsum from the salt range in the Northern Punjab, these deposits now lie in Pakistan, and other sources of supply have had to be found, notably deposits in Bikaner and Jodhpur.

Staffing of the factory has necessitated the recruitment of some personnel from overseas to fill senior posts on short-term agreements of 3-5 years, the policy being to train Indian Nationals to take their places on termination of these contracts. Most of the staff are Indian Nationals, some of whom have been trained in the U.K. and U.S.A. in the operation and maintenance of similar items of plant and these form the nucleus of the operational organisation.

Commissioning of the factory took nearly a year, the first boiler being lit in December 1950. After testing auxiliary equipment the first turbo-alternator was commissioned in February 1951. In April of the same year the first unit of the gas plant was commissioned and in August the first production of pure anhydrous ammonia was made.

Commissioning of the sulphate plant was going on side-by-side with this preliminary work and eventually on October 30 last year Sindri's first batch of sulphate of ammonia was delivered to the silo. The official opening ceremony of this the largest artificial fertiliser factory in Asia was recently performed by Pandit Nehru, Prime Minister of India.

RESEARCH DEVELOPMENTS

Warfarin—A New Chemical Rat Exterminator

THE British Ministry of Agriculture and Fisheries has recently announced that research started in Britain and later taken up in the United States has produced a development which may well be revolutionary in rat extermination.

The first discovery of the possibility of the use in rodent control of a blood-anticoagulant must go to the credit of a British firm of manufacturing chemists, Messrs. Ward, Blenkinsop and Co. About four years ago they submitted to the Director of Infestation Control of the Ministry of Agriculture their ideas on the subject based on experience with laboratory rats and asked, if the Ministry was satisfied that there was a case for investigation, that this should be undertaken in the Ministry's Laboratories, since they had not the requisite facilities themselves. As this seemed a promising line, it was decided to take up the work in the laboratories of the Department. The firm supplied the particular chemical 'Dicoumarin' and laboratory and field work showed that if it was administered in several successive meals it produced internal haemorrhage and capillary damage, which resulted in the seemingly painless death of the animal.

Unfortunately the concentration of chemical required in the food bait was such that it produced unpalatability, with the result that a proportion of the rats avoided the baits. As the method of treatment involved successive feeding from the baits for several days and no interference with the baiting points, this seemed a fatal obstacle to its effective use for rat clearance.

The American workers had meantime taken up the idea and found that another material in the same family of chemicals as Dicoumarin could be used in a much lower concentration, and did not appear to give rise to unpalatability in the food-bait. This chemical has been the basis of subsequent work and is now known internationally as Warfarin (chemically it is 3 (alpha - phenyl - beta - acetylethyl) - 4 - hydroxycoumarin).

Formulation

The Ministry's scientific staff conducted a series of field tests in town and country, with encouraging results. It then remained for more experience to be gained about the limitations on its use in particular surroundings.

In this work, the Local Authorities and County Agricultural Executive Committee were asked to co-operate on a plan laid down by the Ministry.

The Ministry prescribes a formula for the use of Warfarin in two strengths, *i.e.* a concentration of (*a*) 0.005% and (*b*) 0.025% Warfarin in baits for use (*a*) against common rats and (*b*) against ships' rats or mice. It is required of the manufacturers that Warfarin shall be produced in a master-mix containing (*a*) 0.1% and (*b*) 0.5% respectively by weight of Warfarin in fine oatmeal, or other approved material, to facilitate even distribution of poison in the final bait preparation which is made by the addition of one part (by weight) of the master-mix to 19 parts of medium oatmeal or other approved material. As the baits should remain in position for a number of days without disturbance they have to be laid in suitable containers to prevent scatter and loss.

Where these conditions are observed it is established that Warfarin is extremely effective as a rodenticide. Not only is it equally effective as the strong poisons which require a course of prebaiting with plain food, but it involves much less risk to human beings, poultry and other stock from accidental ingestion. It appears to be a painless killer of rats and mice and low concentrations could only be really harmful to people and livestock if taken repeatedly in quantity.

The effect of strong poisons on rats is to create a prejudice against the food in which the poisons are contained, necessitating the use of different food bases and poisons where repetitive treatment is necessary. As Warfarin does not appear to build up a similar prejudice in the animal, there seems no need to alternate it with other poison baits. Warfarin is not, however, at present recommended for use in sewers.

Warfarin is now being produced to the Ministry's specification by several commercial suppliers.

Technical News

Khellin, an anti-asthma drug, and other drugs obtained from the seed of Ammi Visnaga are the subjects of an article in the current issue of *Manufacturing Chemist. Chemical and Process Engineering* this month includes an article in the treatment of waste waters from penicillin manufacture. Petroleum Progress in South America is the subject of an article in the current issue of *Petroleum*. The *Muckshifter and Public Works Digest* carries an account of the New Jersey Turnpike in the U.S.A.

Use More Bees

BEES pollinate flowers, and until recently agriculturists were content to leave it at that. Few attempts were made to assess the efficiency of this 'pollination service' or to discover ways to boost the effectiveness of these useful insects. Bees are brought into orchards to help pollinate flowers and largely for the honey they incidentally produce. The number of hives per acre is often determined only by considerations of honey output per hive. Recent American work on alfalfa, however, clearly crystallises the need to use more bees, because the loss of honey is more than compensated for by increased seed yields when large numbers of hives are brought into an alfalfa field.

In alfalfa grown for seed, G. H. Vansell (USDA, Circular 876) has shown that bees tend to work flowers nearest to the hive and that seed yields 100 yd. from a hive were greater than yields from plants 1,000 ft. farther away. In one field each day only about 4% of the alfalfa flowers were pollinated by casual bee visitors, but after several hives had been brought into the field the pollination rate jumped to 12-40%. On an even larger scale are the observations at Delta, Utah. Here, during the years 1943 to 1947, there was a direct relationship between the average seed yield and the number of hives in the district. The more bees there were, the greater was the acreage seed yield in this alfalfa-growing community. Thus in one year, when the seed harvest was 60 lb. per acre, there were only 6,900 hives in the area; the highest yield of 168 lb. was cropped when there were 11,100 hives present.

Hive density per acre for the maximum seed yield exceeds that for optimum honey production. From alfalfa flowers the nectar flow gave the highest return per hive at the rate of one hive per acre. The flow will support more colonies, but honey yields decline. On the other hand, one colony per acre is not enough for the most efficient pollination of the seed crop and so a balance had to be struck during Vansell's survey, when sub-optimal honey yields were weighed against less than maximum seed cropping. Financially the farmer gained by backing the seed crop.

Vansell's survey shows how clearly the need exists for weed control in and around alfalfa fields because many weeds and some crops compete with the alfalfa for the bees' services. When chicory, *Grindelia* and *Melilotus*, flowered at Logan, Utah, concurrently with alfalfa, bees ignored the seed crop. On the other hand, bees freely

(*Concluded on page* 220)

One of the villages in the heart of the Natal sugar belt. Note the sugar mill on the right

South African Sugar Technologists' Association Annual Congress

The 26th Annual Congress of the South African Sugar Technologists' Association was held in Durban during the period February 19 to 22, the final sessions taking place at the Experiment Station of the South African Sugar Association at Mount Edgecombe.

THE Congress was officially opened by Dr. T. S. H. Rossouw, Chairman of the Sugar Industry Central Board, who addressed a large and representative gathering on the subject of the recent development of the sugar industry and the problems of future expansion. Dr. Rossouw traced the expansion of the industry during the past half century, pointing out that during the latter half of that time the Technologists' Association had played an important part. Local consumption had increased remarkably and further expansion was urgently necessary to satisfy local demands and to retain a place in the Commonwealth export market. A record crop of 607,845 tons* was produced in 1948/49, and of this amount local consumption accounted for 567,908 tons. From being a substantial exporter South Africa was now finding it difficult to satisfy the still increasing local consumption. Although a target of 725,000 tons had been set for the 1952 crop this could not be attained, principally because of the effects of three years deficient rainfall. Dr. Rossouw suggested the possibility of organising the growing of sugar cane in suitable parts of the native reserves in the coastal belt of Natal. The encouragement and help of the Native Administration Authorities would be essential to success. Although careful planning would be required, difficulties were not insurmountable.

South Africa, with other Commonwealth countries, was a party to a long term agreement with the United Kingdom under which their share of the export market was 200,000 long tons annually at prices negotiated from year to year in accordance with an agreed formula. An estimate of 800,000 tons for the annual consumption within the Union was by no means an extravagant figure, so that within the near future the industry should plan for a total average output of 1,000,000 tons a year.

The President of the Association, Mr. G. C. Dymond, spoke on the subject of the utilisation of organic wastes, advocating the conservation and use of humus forming material in the form of town wastes, which could be recovered and applied to the land.

The formal opening proceedings were followed by a series of papers on technological and agricultural subjects, which included two of importance in connection with the computation of the price paid for cane.

The Java ratio

W. O. Christianson dealt with 'Cane Testing, with Special Reference to the Use of the Java Ratio in Natal.' He traced the factors which influence the Java Ratio, pointing out that the most important is the fibre percentage of the cane, no matter whether this is introduced as trash or tops or is derived from the stalk. Maturity of the cane, disease and the period between the time of reaping and crushing also affects the figure. The Java Ratio varies inversely with the fibre content. There is no true correlation between the Java Ratio and the total sucrose in the cane. Cleanliness of the milling plant is of high importance. Under the present system by which payment is made on the basis of the sucrose content of the cane delivered, that figure is determined by ascertaining the sucrose percentage of the crusher juice and multiplying it by the Java Ratio, which is ascertained weekly. Approximate daily figures are used which are notified to the growers, but under working conditions it is not possible to arrive at a strictly correct ratio each day. The work described in this paper is a contribution to the general study of the method of determining cane prices in a manner which will safeguard the interests of both the miller and the grower.

Related to the same consideration is 'The Direct Determination of the Fibre Content of Individual Cane Consignments,' discussed in a paper by A. F. McCulloch, who suggested a scheme for the continuous weighing of the bagasse from the mill train in order to determine the fibre content of cane consignments.

Other papers of a technological nature discussed the deterioration of raw sugars

* Short tons of 2,000 lb.

during storage, the acid clarification of cane juice and the chemical laboratory reports for the crop year 1951/52.

Cane breeding

Of more direct interest to the planters were the papers on cane breeding and various aspects of field practice. Mr. A. de Sornay, Plant Breeder at the Sugar Cane Research Station at Mauritius, gave an address on cane breeding work in that colony. He traced the technique used, pointing out differences with practice of other cane breeding stations, among the more important of which were the type of lantern used for enclosing the male and female tassels and the early stages of selection of seedling canes. Actual crossings were made in the field in lanterns constructed of upper and lower portions of cloth with a central cylinder of glass. These were suspended over the female cane from a crosspiece attached to a vertical post to which was fastened a container for the preserving solution in which the cut end of the male parent cane was placed, the arrow being enclosed in the lantern. It was found that the best solution for their conditions was 0.03% SO_2, which was renewed every day, a node of the stalk being cut and removed at the same time. 20,000 to 30,000 seedlings were obtained each year.

Final selection was made from ratoons only, as ratooning power in Mauritius is highly important. An endeavour was being made to determine ratooning power by cutting cane back several times a year and observing the succeeding growths.

'Progress in Sugar Cane Breeding in Natal' was the subject of a paper by P. G. C. Brett, Plant Breeder, S.A. Sugar Association Experiment Station, who described the breeding programme now being conducted, and referred to details of the special methods being used to obtain fertile seed. The first seedlings of commercial types of sugar cane raised from seed set in Natal were obtained in 1944, since when intensive study of the conditions under which fertile seed is produced have been made. This work has resulted in the provision of a special glasshouse with individual compartments under automatic temperature and humidity control, in which the male and female parent canes are placed at the correct time so that the pollen may mature and crossing occur. It has been found recently that canes kept in the glasshouse during the whole of the required period are inferior in pollen fertility to those which are placed in the open during the day and in the glasshouse at night. A further attempt to raise seedlings by using pollen introduced from Mauritius failed, probably because of unforeseen delay in the air transport arrangements which resulted in pollinations not being made until a week after the pollen had been collected. Introductions of cuttings have been extended to include non-commercial varieties useful for breeding, which are brought in through the quarantine station in Durban. Mr. Brett concluded by saying that although difficulties which did not occur in tropical countries restricted sugar cane breeding in Natal, the work was now well established and more than 32,000 seedlings were planted in the field during the past three years.

Members of the 1952 S.A. Sugar Technologists' Congress: (*Front row from the left*) **4th, Dr. H. H. Dodds; 5th, Dr. A. A. McMartin; 6th, A. de Sornay; 7th, G. C. Dymond (President); 8th, Dr. G. S. H. Rossouw; 11th, A. C. Barnes**

Fertilisers and field management

C. H. O. Pearson, the chief Agricultural Officer at the Station, presented papers on the treatment of trash, fertiliser applications and field management between successive cane crops. While no general conclusions in regard to fertiliser applications were arrived at, it was clear that different districts require individual attention. The burning of cane prior to harvest had replaced trashing cane in the field, the change apparently being brought about by shortage of labour. A comparison indicated advantages in retaining a blanket of trash on the field provided it was removed from the cane rows. Trash left over the stools under damp cold conditions seriously affected ratoon growth and caused the death of many stools. Under more favourable conditions in well drained land trash might be left undisturbed, though it was clearly an advantage to remove it from the line of cane, particularly when reaping occurs early in the season. Trials in different areas are being continued with the object of studying the effect of different methods of trash treatment and fertiliser application.

The paper on field management between cane crops discussed the effects of using green cover crops which were ploughed in several months before the new cane crop was planted. Under such conditions the land was left practically bare for a period of nine to eleven months and the effect of the green crop appeared largely to be lost. It was suggested that two successive green manure crops be used between the ploughing out of the old stools and the replanting of the field more than a year later. Alternatively short fallowing should be considered, which would involve ploughing out in July and replanting with cane before the end of the year.

A. C. BARNES

Use More Bees—

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collected pollen from alfalfa in areas where no weed competition existed. Some crops grown at the same time and in the same district as alfalfa also divert the bees' attention; for example, it was noticed in California that pollinators more frequently visited alfalfa fields after an adjacent area of mustard had been cut.

Weather conditions affect the bees' activities in two main ways. Such obvious features as high winds, rainfall, low temperature and cloudiness discourage flight. These factors, however, also operate on the crop and by altering the attractiveness of the alfalfa they secondarily modify the bees' work. Bees pay most attention to those alfalfa flowers which have the highest sugar content in the nectar; sugar content in its turn is affected by the irrigation of the soil. Nectar from recently irrigated plants may contain as little as 29% sugar, while from a dry plot sugar content sometimes rises to 63%. Practical tests show that more bees visit flowers grown on moderately dry land than on recently irrigated soil.

ALAN GOODMAN

FARM MACHINERY

Australian Farmall Production

The 8,000th Farmall tractor to be manufactured by the International Harvester Co. of Australia since 1946 recently moved off the production line at the company's large farm equipment plant located at Geelong, 44 miles south-west of Melbourne. Currently producing tractors at the rate of 300 per month, Geelong Works, as part of the manufacturing facilities of the International Harvester Co. of Australia Pty. Ltd., has turned out more than 3,000 in the past year alone.

The plant also produces power units and a complete line of farm implements, all especially designed and tested for service in Australian farming areas.

Expansion at Geelong Works has been rapid, particularly since 1948. The addition of a modern mechanised grey-iron foundry, automotive machine shop and other facilities has enabled the plant to manufacture a still greater variety of equipment.

Mobile Irrigation Pump for India

Harry Ferguson Ltd. announce that they have placed contracts in India for the manufacture of 1,000 tractor-mounted irrigation pumps. Production has already started on the first batch of 50 pumps which are to be used for demonstration.

The pumps are being made under licence by the British India Electric Construction Co., a subsidiary of Balmer Lawrie and Co. Ltd., Calcutta. The contract provides for the production of 100 pumps a month and it is intended that they will be available for irrigation work during the coming dry season.

The pump is of the centrifugal type and has a maximum output of 185 gal. per min. at 1,975 r.p.m., at which speed it has a head of 70 ft. and absorbs 6.1 h.p. Drive is by belt pulley through an endless, all-weather belt.

The cradle was designed in Coventry after experiments in India. It enables the pump to be carried on the three-point linkage and incorporates a check link and rack on which the pump is suspended when in work and which ensures constant belt tension, however uneven the ground may be. Raising the pump to the transport position by fingertip control automatically slackens the belt and stops the pump. The tractor is fitted with brackets for carrying the 3-in. suction hose and delivery pipes.

An Australian-built International Harvester motor truck fitted with a Doncaster-made bale loader, at work in the foothills of the Strathbogie Ranges, 72 miles north-east of Melbourne

Using the tiller ridger on the Clifford Model A1/16 for potato planting. When planting is finished the ridger is removed and the machine run between the rows to cover up. The ridger is used for banking up later on. The machine was fitted with a new type cutter tine and put straight on to stubble with a considerable growth of grass

A 'Spider' thatch-making machine at work in Kenya, producing a matting material. The manufacturers of this machine are Harvest Saver and Implement Co.

A Mounted Knapsack Sprayer

A simple rubber-tyred two-wheeled truck has been designed by the Four Oaks Spraying Machine Co. of Birmingham for carrying their 'Kent' pneumatic knapsack sprayer. The sprayer is mounted on the truck by one clip, easily removable, thus rendering the truck available for light carting jobs in the orchard or farm.

The 'Kent' is a brass pneumatic knapsack sprayer with internal pump and fitted with pressure gauge and stopcock, available in three patterns with working capacities of one, two and three gallons respectively. The price of the Mobiliser truck is £3 17s. 6d.; cost of the whole apparatus, 'Kent' sprayer plus truck, is £18 7s. 6d.

Reclamation by Rotavator

A demonstration of reseeding land which had been completely reclaimed by a Howard Rotavator attached to a David Brown Cropmaster was recently given by David Brown Tractors Ltd. The field, 4½ acres in area, was rotavated for the first time in 5½ hr. with a consumption of 4½ gal. A further rotavation next day took 7 hr. with a consumption of 7 gal. Four days later the field was gone over three times with the Rotavator in 8½ hr. and using 9 gal. Next the field was limed (4 tons), one man taking 9½ hr. to collect and apply it. A further rotavation (7 hr.) was then given before sowing and working in the grass seeds. Records of the results, including costs, will be published on completion of the experiment.

The Howard Rotavator for the David Brown Cropmaster is attached direct to the tractor and driven direct from the tractor power take-off shaft through a universal coupling. Cultivation is done by hoe-shaped blades. Width of cultivation is 50 in.; depth of cultivation is adjustable to a maximum, in most soils, of 9 in. The blades turn in the same direction as the landwheels of the tractor, creating a forward thrust which assists both tractor and Rotavator forward.

180 h.p. British Tractor

The first heavy track-type tractor to be designed and built in Britain was launched on St. George's Day by the Secretary for Overseas Trade, Mr. H. L. D'A. Hopkinson. Now users all over the world who have previously had to rely on the American market for such machines will be able to specify a British tractor. The tractor is the Vickers VR 180, the frame and equipment being made by Vickers-Armstrong Ltd., and the 180 h.p. six-cylinder oil engine by Rolls Royce. The organisation of world-wide distribution and servicing of the tractor and its ancillary equipment has been entrusted to Jack Olding and Co. Ltd.

The VR 180 has a fully articulated suspension, cush drive for speed with less vibration, six forward and three reverse gears, top speed of 9.73 m.p.h., sealed lubricated tracks and unit construction. Special attention has been paid to operating in extremes of temperature and the cooling system has been protected from dust; the oil temperature is controlled by a heat exchanger built into the engine.

It is hoped that by next October an output of 50 of these tractors will be achieved and that during 1953 1,000 will be produced. Of the Commonwealth countries, orders for the VR 180 have already been received from New Zealand, South Africa, the Rhodesias and Anglo-Egyptian Sudan, whilst Australia, Ceylon, India and Pakistan are expected to place orders in the near future.

Vickers are now designing a smaller machine which, it is expected, will have an equally important place in the world requirement for earthmoving equipment. Also, the design of even larger machines than the VR 180 is under consideration.

Ford Price Increases

Ford Motor Co. Ltd. announce that, effective May 1, 1952, prices of the New Fordson Major Tractor will be increased. The new prices are as follows:—

	£	s.	d.
Row Crop Tractor, pneumatic tyres, steering brakes, vaporising oil engine, coil ignition, electric starter	465	0	0
Row Crop Tractor, pneumatic tyres, steering brakes, vaporising oil engine, coil ignition, electric starter, lighting, hydraulic lift and linkage, pulley and power take-off	540	10	0
Row Crop Tractor, pneumatic tyres, steering brakes, petrol engine, coil ignition, electric starter	465	0	0
Row Crop Tractor, pneumatic tyres, steering brakes, petrol engine, coil ignition, electric starter, lighting, hydraulic lift and linkage, pulley and power take-off	540	10	0
Row Crop Tractor, pneumatic tyres, steering brakes, diesel engine, electric starter ..	565	0	0
Row Crop Tractor, pneumatic tyres, steering brakes, diesel engine, electric starter, lighting, hydraulic lift and linkage, pulley and power take-off ..	640	5	0

The Ford Motor Co. reports that courses on the new Fordson Major tractor and implements are now in full swing at the school in Leamington where, in addition to dealers from home and overseas, Government officers and others may also receive instruction. Each course lasts for five days and all classes are confined to ten students at a time.

Trailer Manufacturer on Overseas Tour

We are informed that Mr. A. Carleton Whitlock, managing director of Whitlock Bros. Ltd., Great Yeldham, left the U.K. at the end of April on an overseas tour through Europe to Turkey, followed by visits to his agents in Karachi, Lahore, Jodhpur, Delhi, Calcutta and Bombay. From India Mr. Whitlock flies to East Africa, where his company have taken a stand at the Royal Kenya Show to be held in Nairobi. He hopes to arrive back in this country to meet his many friends at the 'Royal' at Newton Abbot.

THE 1952 B.I.F.

The British Industries Fair opened its doors for the 31st occasion on May 5, 1952, at Earls Court and Olympia in London and at Castle Bromwich in Birmingham. The displays took the form followed in previous years, although they were noticeably more restricted than last year, when it will be remembered that, owing to the fact that it was Festival year, the effort was made to render the display more than usually attractive and comprehensive. The attendance figures also appeared to be appreciably less, although it is understood they are officially regarded as satisfactory.

In any case, the exhibition being mainly concerned with British manufactured goods it is only of secondary interest to agriculturists, although there are always some sections which contain exhibits of interest to planters and farmers. Usually, however, it is the agricultural shows like the Royal, the Bath and West or the Smithfield Show which have the greatest attractions for the agriculturally minded and at which the bulk of the business in farmers' and planters' requirements is done.

Agricultural machinery exhibited in limited numbers appeared at Castle Bromwich; among them were included displays by Messrs. Christy and Norris of farm grinding and disintegrating machinery, Messrs. Ransomes, Sims and Jeffries with a wide range of motor, electric and hand mowers, Scottish Mechanical Light Industries with a range of hammer mills for feed grinding and the Wolseley Sheep Shearing Company with clipping machines for sheep and cattle, electric fencing, dairy utensils, petrol and paraffin engines and their radio ferret.

At Olympia among the exhibitors classified under chemical manufacturers were Imperial Chemical Industries with fertilisers, insecticides and fungicides, Shell Chemicals with a range of insecticidal and fungicidal products derived from petroleum and Messrs. Hickson and Welch with a range of agricultural chemicals.

Among the exhibits at Earls Court, the Commonwealth display again calls for special mention. It comprised displays from the majority of the Commonwealth countries, including the Dominions and the Colonial Dependencies.

N.I.A.E. Open Day

The public will have an opportunity of seeing aspects of the work of the National Institute of Agricultural Engineering at an Open Day to be held on July 24, this year.

The headquarters of the N.I.A.E. is at Wrest Park, Silsoe, Bedfordshire.

DEMONSTRATIONS AND LECTURES

British Farmer-Inventors

DR. A. J. HOSIER was the principal speaker at a recent meeting in London of the Institution of British Agricultural Engineers, when several members described inventions and home-made gadgets which they had designed on their farms.

Dr. Hosier may justly be termed the doyen of farmer-inventors in Britain, having designed his own inventions on and off for the last fifty years. In his paper he emphasised that nearly always it has been an economic necessity that has been the mother of his inventions. More difficult than the actual inventing, he considered, was convincing manufacturers of their feasibility and generally he has had to work the machines on his farm for some time before firms would take up the ideas.

Giving a brief account of his inventions, Dr. Hosier said that his first was a prototype side-rake which he built in 1900. Four years later came a mechanical milk strainer which received a bronze medal at the London Dairy Show. Then, after the First World War in 1922, he brought out the famous movable bail milking machine. Two six-stall bails were run by a man and two boys milking 120 cows; it took four years to convince farmers of the practical advantages afforded by this then revolutionary system of open-air milking. In 1928 the bail was exhibited at the Royal Show and gained a silver medal.

Another silver medal was won in 1929 for a system of cooling milk by vacuum, and in 1934 a further silver medal was received for a Hosier-invented milk recording outfit.

The Apex movable poultry fold, introduced in 1930, was another important labour-saving device: 150 units, each holding 25 birds, enable a man and boy to feed and water nearly 4,000 birds. In 1934 a method of ploughing, pressing, seeding and double-harrowing all in one operation was introduced.

A reversible plough has recently been jointly produced by Dr. Hosier and Mr. E. R. Bomford. The beam of this plough carries the plough bodies, the number and spacing of which can be altered. Castor wheels are fitted at the back so that the tractor may reverse if necessary.

Dr. Hosier is now hoping to design a fertiliser distributor which will be made of some anti-corrosive material so that it can be left, as he said, ' half full of fertiliser for three months without damage.'

Other inventions mentioned were a 30-ft. broadcast drill for grass seeds with three 10-ft. harrows following behind, a motorised grass mower made from an old motor car chassis, and a method of converting a rubber-tyred tractor to crawler half-track taking only 20 minutes to do the whole job.

Following Dr. Hosier, a farmer from North Kent, **Mr. Fred Barker,** described some of the labour-saving gadgets he has improvised on his farm. Among these was an ingenious method of filling a clamp with the minimum of labour involved in shifting sacks. A tractor pulling a trailer with a load of full sacks moves slowly along the side of the clamp, while from the top of the trailer a level catwalk extends at right angles over the top of the clamp and is supported by a wheel on the other side. In this way the unloader can drag or push in a trolley the sacks along the catwalk and directly over the required section of the clamp for unloading.

Hanging doors on the tractor shed was another of Mr. Barker's inventions. These doors are hinged at the top with two ropes leading from the bottom corners of each door up to the wall above, through pulleys, and down to weights hanging free at the end of each rope. The object of this system is to enable work to be carried out on the tractors with the doors open, whatever the weather may be, without rain coming into the interior of the shed.

Various members of the Institution followed the two principal speakers and gave details of their own inventions. **Mr. E. C. Claydon** described a system of sliding valves for the central ventilating duct of a grain storage plant. **Mr. W. G. Hughesdon** described a power-operated mounted seed drill for beans, peas and maize. This machine employs a rotary-tube principle, the seed feeding from a centrally mounted hopper into a horizontally revolving tube and being thrown out at either end. The inventor claims that beans can be planted a regular half inch apart by this method.

The contributions to the meeting were summed up by another well-known farmer-inventor, **Mr. Rex Paterson,** who is best known for his buckrake. He said that, unlike Hosier who builds his machines from nothing, *i.e.* no standard base, he prefers to start with a standard machine and adapt it to his needs. In this way the invention, if successful, will be more available for others to use. Also, unlike Hosier, he prefers fixed buildings for his stock, each set of buildings serving a unit of land or group of fields around them.

Marginal Land Reclamation in the Modern Manner

THE use of land machines, helicopters and fixed-wing aircraft for lime and fertiliser spreading and spraying was demonstrated on May 6, at Ivinghoe Beacon, Bucks, by Pest Control Ltd., who in 1949 inaugurated the first helicopter spraying service in the United Kingdom.

Three types of mechanical spreaders were shown, a trailer type and two lorry operated ones which did a good job of distribution on reasonably firm and level ground, working on the spinning disc principle. These machines belonged to Markjohn Mechanical Spreaders Ltd., which is now associated with Pest Control Ltd. On hilly land of gradient more than one in six or on marshland, these machines cannot be operated and it is under such conditions that aerial application is the only solution. The first machine to be shown working over a steep hillside was a modified Hiller helicopter, the type used for spraying cotton in the Sudan. Carrying a 4 cwt. load of lime the Hiller skimmed only a few feet above the hillside and although there was a certain amount of wind, the bulk of the lime fell direct and drift was not excessive.

A second helicopter demonstrated the spraying of a mixture of nutrients and Phenoxylene weedkiller at 5 gal./acre ; this method has given striking results in the treatment of weed and rush infected marshlands (see WORLD CROPS, III, 12, p. 476, December 1951). Also seen spraying nutrients was an Auster aircraft. This plane requires a landing strip of about 500 yards and is not, therefore, so adaptable as the helicopter.

To save time in ferrying flights from airstrip to spraying site the bigger the quantity of spray taken up the better and a bigger type plane shown was the De Havilland ' Beaver,' at present made in Canada and widely used in that country, Australia and New Zealand. The ' Beaver ' can carry 200 gal. of spray, fly comparatively slowly and climb at a steep angle.

Many distinguished agriculturists watched the demonstration, including Lord Boyd Orr, Chairman of Pest Control Ltd., Lord Carrington, Parliamentary Secretary to the Ministry of Agriculture, Sir Frank Engledow of Cambridge University, Sir Reginald Franklin, Deputy Secretary of the Ministry of Agriculture, Sir William Ogg, Director of Rothamsted Experiment Station, and Sir James Scott Watson, Head the N.A.A.S.

WORLD CROP REPORTS

BRITISH EAST AFRICA

Tobacco prospects. Returns made in October for **S. Rhodesia** indicated that some 2,500 growers would be planting 193,000 acres of flue-cured tobacco, which, assuming a yield per acre equal to the average of recent years, should give a crop of some 120 million lb., or 16 million lb. more than the record crop of 1949-50. Weather conditions were at the outset good, early rains falling in most areas and encouraging early plantings, while subsequent conditions have been favourable for carrying out the full planting programme.

Tobacco production in **N. Rhodesia** has shown a remarkable expansion since the war, and in 1950-51 for the first time exceeded 10 million lb.

In the current season, in the Western area the number of growers has risen to 307 as against 188 last season, and a flue-cured crop of at least 8 million lb. is anticipated; a further 6 million lb. is expected from the Eastern area.

According to the December crop report of the **Nyasaland** Department of Agriculture, planting was in full progress in the Central Province, while in the Southern Province all dark-fired tobacco planting had been completed by the end of the month except in the Mlanje area. In the Central Province growing prospects were considered very favourable, but in the Southern Province excessive rain was tending to retard growth. Little disease was reported.

(From *Tobacco Intelligence.*)

GREECE

The 1951 tobacco crop estimate has now been reduced to 128.5 million lb., so that despite the decline in the area under tobacco—from 254,000 acres in 1950 to 239,000 acres in 1951—last year's crop still remains slightly above that of the previous year and only 3% below the average for 1935-39.

(From *Tobacco Intelligence.*)

PAKISTAN

Record 1951 tea production. A record quantity of 53.1 million lb. of tea was produced in Pakistan during the year 1951 despite unfavourable weather conditions and occasional damage to tea bushes by hailstorms and droughts. The amount of tea produced in Pakistan was 43.8 million lb. in 1948, 46.3 million lb. in 1949 and 52.2 million lb. in 1950.

The area under tea cultivation has also increased considerably. It has risen from 75,500 acres in 1948 to 81,600 acres in 1951. The total acreage permissible under the International Tea Agreement 1950-55 for Pakistan is 83,700 acres.

More rape and mustard this year. The first forecast of the area under rape and mustard for the year 1951-52 is 1,532,000 acres as against 1,490,000 acres reported in the first forecast of the previous year and shows an increase of 2.8%. The acreage reported in the final forecast of last year was 1,626,000 acres.

WORLD CROPS

OUR NEXT ISSUE will be partly devoted to **the tobacco industry.** Principal articles will include:—**Tobacco Cultivation and Processing,** by J. Grindrod; **The Southern Rhodesian Tobacco Industry,** by I. H. Morten. There will also be accounts of tobacco cultivation and production in the various major producing countries of the world.

Jealotts Hill Research Station is the subject of the seventh article in our series Industry's Contribution to Agricultural Research. The additional other articles and features will appear as usual.

ISRAEL

1951 achievements. About 125,000 tons of fodder kernels, barley, oats, corn and maize were grown in 1951 compared with 33,700 tons in 1950; oil seeds—10,000 tons as compared with 250 tons; vegetables—255,000 tons instead of 145,000; potatoes—53,000 tons instead of 36,000; 10,000 tons of sugar beets (a new crop).

Collective, cooperative and private farming units, which numbered 18,000 before the State's establishment, and which now number more than 41,000 in Jewish hands and 15,000 in the Arab sector, should increase by another 5,000 units this year.

Another 220,000 dunams were brought under irrigation—a doubling of the area of irrigated land in less than four years. Vegetable and fodder areas increased from 104,000 dunams to 340,000 dunams.

Since the establishment of the State, 25 million trees have been planted by the Jewish National Fund, the Army, the Government and private persons, on about 125,000 dunams.

The 693 tractors in the country at its inception have increased by about 4,000.

BRAZIL

1951 production. During 1951 Brazil's agricultural production reached 66,836,485 tons, valued at 55,500,000,000 cruzeiros, representing an increase of 773,051 tons and 4,337,000,000 cruzeiros over the figures for 1950. The most important products were the following:

	Tons	*Value in million cruzeiros*
Coffee	1,159,487	17,316
Ginned cotton	388,105	8,190
Maize	6,342,045	5,868
Unhulled rice	3,237,051	5,634
Sugar cane ..	32,687,184	3,259
Manioc ..	12,619,934	3,149
Beans	1,253,504	2,310
Potatoes ..	726,718	1,346
Wheat	495,104	1,215
Cocoa	164,041	1,104
Bananas (stems)	167,189,000	1,043

Other more important crops were (figures in million cruzeiros): tobacco, 739; oranges, 658; sweet potatoes, 452; grapes, 377; castor seed, 359; groundnuts, 336; onions, 313; coconuts, 267; and tomatoes, 264.—*Reuter.*

MADAGASCAR

1951 tobacco crop. Madagascar's 1951 tobacco crop is estimated at 15% above the 1950 output.

The country's 1951 tobacco harvest is estimated at 11.7 million lb. from 21,140 acres, compared with 10.2 million lb. from 19,397 acres in 1950. Yield per acre for the 1951 crop is placed at about 580 lb. compared with only 525 lb. in 1950.

SWITZERLAND

Grain production. Production of bread grains in Switzerland in 1951 was forecast at 321,000 metric tons, a gain of 45.5% above the 1931-35 average of 220,500 tons, and about 2.8% above 1950 production of 312,300 tons, but 9.2% below the fine crop of 348,000 tons in 1949. The increase in 1951 above 1950 was due primarily to greater winter wheat production, which in 1951 equalled 218,000 tons, almost the entire bread-grain crop of the annual average in 1931-35. Production of rye remained stationary.

Coarse grains showed a production increase of 209% above 1931-35 average (110,000 tons as compared with 34,900 tons) and 11% above 1950 (98,700 tons) but declined 24.5% as compared with 1949 (152,200 tons).

Total estimated cereal production in Switzerland in 1951 (436,000 tons) will exceed that of 1931-35 (257,700 tons) by 69%, and that of 1950 (415,800 tons) by roughly 2%, but it is about 14% below that of 1949 (507,500 tons).